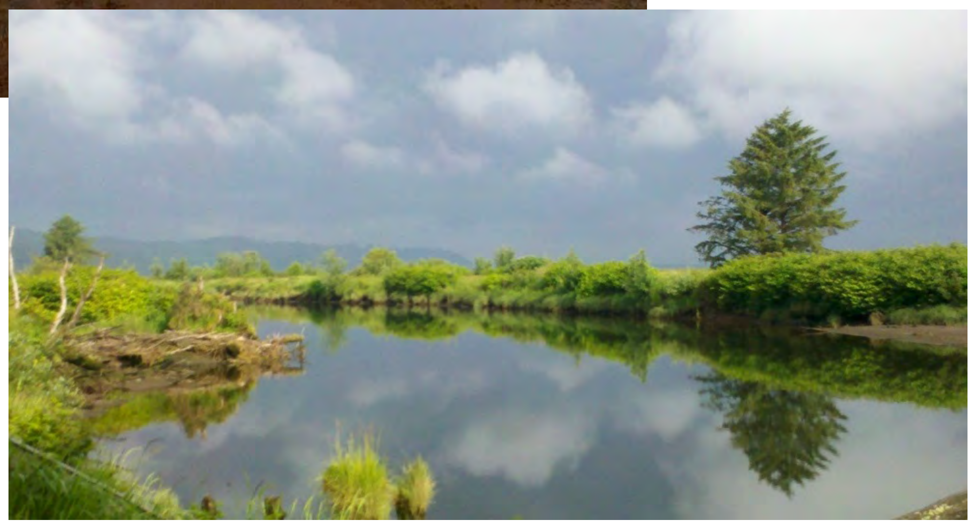

Draft Environmental Impact Statement

Southern Flow Corridor Project

DR-1733-OR

Tillamook County, Oregon

May 2015

Federal Emergency Management Agency
Region X
Department of Homeland Security
130 – 228th Street SW
Bothell, WA 98021

This document was prepared by:

Contract No.: HSFEHQ-12-D-0881
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Draft Environmental Impact Statement

Lead Agency: U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA) Region X

Cooperating Agencies:
National Oceanic and Atmospheric Administration (NOAA) Restoration Center, U.S. Fish and Wildlife Service (USFWS), United States Army Corps of Engineers, Port of Tillamook Bay (POTB), Tillamook County

Title: Southern Flow Corridor Project, Tillamook County, Oregon

Designation: Draft Environmental Impact Statement

Location: Tillamook County, Oregon

Information Contact: Mark Eberlein, Regional Environmental Officer,
Region X, FEMA, 130 - 228th Street SW, Bothell, WA 98021
425-487-4735

Abstract:
The Southern Flow Corridor Project Draft Environmental Impact Statement (EIS) evaluates the environmental effects that could occur if activities to reduce flood damage and restore Coastal Coho habitat in the Tillamook Bay estuary are implemented. FEMA received a Public Assistance grant program application from POTB for the Southern Flow Corridor project as an alternate project to the repair of its rail line that was damaged by flooding and severe storms in December 2007. Funding for the project is proposed to come from FEMA, NOAA Restoration Center, USFWS, and other state and local partners. The Proposed Action would remove approximately 6.9 miles of levees, modify 2.9 miles and construct 1.4 miles of new setback levees, and restore tidal wetlands on 522 acres. The proposed project area is located west of the City of Tillamook and is intended to provide flood reduction benefits over a broad area in the lower Tillamook Valley. The Proposed Action would include work in floodplains and wetlands. Alternatives include the Hall Slough Alternative, which would provide some flood reduction and habitat restoration benefits in a different location, and the Southern Flow Corridor – Initial Alternative, which would encompass a slightly larger area than the Proposed Action. The Draft EIS addresses direct, indirect, and cumulative impacts resulting from construction and long-term implementation of the Proposed Action and alternatives including, the No Action Alternative, on the physical, natural, and socioeconomic environment of the region.

Reviewers should provide their comments to FEMA Region X during the comment period of the Draft EIS. FEMA will analyze and respond to the comments and will use the information acquired in the preparation of the final environmental impact statement (Final EIS). Reviewers have an obligation to structure their participation in the National Environmental Policy Act (NEPA) process so that it is meaningful and alerts the agencies to the reviewers' position and contentions. Comments on the Draft EIS should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 Code of Federal Regulations (CFR) 1503.3).

Comments on this document must be submitted by July 13, 2015.

Send Comments To: SFC-EIS, FEMA, Region X, 130 - 228th Street SW, Bothell, WA 98021; email: fema-sfc-eis@fema.dhs.gov; online at www.SouthernFlowEIS.org or fax: 425-487-4613 Attention: FEMA SFC EIS.

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Acronyms and Abbreviations

µm	micrometers
µs	microsiemens
AADT	annual average daily traffic
ACS	American Community Survey
ADCIRC	ADvanced CIRCulation hydraulic model
ADT	average daily traffic
APE	area of potential effect
ATR	automatic traffic recorder
BA	biological assessment
BMP	best management practice
BO	biological opinion
CAA	Clean Air Act
CCMP	Comprehensive Conservation Management Plan
CD	compact disc
CDC	Centers for Disease Control and Prevention
CELCP	Coastal and Estuarine Land Conservation Program
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH_4	methane
cm	centimeter
CMMP	Contaminated Media Management Plan
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	CO_2 equivalent
Co-op	Tillamook Creamery Cooperative Association

CSZ	Cascadia Subduction Zone
CTSI	Confederated Tribes of Siletz Indians
cy	cubic yard
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
db	decibel
dBA	A-weighted decibel
dbh	diameter at breast height
DLCD	Department of Land Conservation and Development
DO	dissolved oxygen
DOGAMI	Oregon Department of Geology and Mineral Industries
DPS	distinct population segment
EC	estuary conservation
ECA	estuary conservation aquaculture
ED	estuary development
EDR	Environmental Data Resources
EFH	essential fish habitat
EIS	environmental impact statement
EN	estuary natural
EO	Executive Order
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	flood insurance rate map
FPPA	Farmland Protection Policy Act

FR	Federal Register
ft	feet
GHG	greenhouse gas
GIS	geographic information system
GPS	global positioning system
GWP	global warming potential
HEC-RAS	Hydraulic Engineering Center's River Analysis System
HMGP	Hazard Mitigation Grant Program
IDP	inadvertent discovery plan
IPCC	Intergovernmental Panel on Climate Change
LiDAR	light detection and ranging
LWI	local wetland inventory
m	meter
Ma	mega-annum
MBTA	Migratory Bird Treaty Act of 1918
MeHg	methylmercury
mg/L	milligram per liter
mL	milliliter
mm	millimeter
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
$MTCO_{2e}$	metric tons carbon dioxide equivalent
M_w	moment magnitude
NAAQS	National Ambient Air Quality Standards
NAVD88	North American Vertical Datum of 1988
NEP	National Estuary Program
NEPA	National Environmental Policy Act

NFIP	National Flood Insurance Program
NH_3	ammonia
NHC	Northwest Hydraulic Consultants
NHPA	National Historic Preservation Act
NHS	National Highway System
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NO_x	nitrogen oxide
N_2O	nitrous oxide
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
O_3	ozone
OAR	Oregon Administrative Rules
OCCRI	Oregon Climate Change Research Institute
ODA	Oregon Department of Agriculture
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
ODSL	Oregon Department of State Lands
OEM	Oregon Office of Emergency Management
OHP	Oregon Highway Plan
ORBIC	Oregon Biodiversity Information Center
ORS	Oregon Revised Statutes

OWEB	Oregon Watershed Enhancement Board
PA	Public Assistance program
Pb	lead
PCE	Primary Constituent Element
PFMC	Pacific Fishery Management Council
P.L.	Public Law
$PM_{2.5}$	particulate matter 2.5 µm or less in diameter
PM_{10}	particulate matter 10 µm or less in diameter
PNWR	Portland Northern & Western Railroad
POTB	Port of Tillamook Bay
PROJECTS	Programmatic Restoration Opinion for Joint Ecosystem Conservation by the Services
PSD	Prevention of Significant Deterioration
PW	Project worksheet
ROD	Record of decision
RV	recreational vehicle
SFC	Southern Flow Corridor
SFHA	Special Flood Hazard Area
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SO_x	sulfur oxide
SOC	species of concern
sq ft	square feet
SWCD	Soil and Water Conservation District
TBHEID	Tillamook Bay Habitat and Estuary Improvement District
TBNEP	Tillamook Bay National Estuary Project
TEP	Tillamook Estuaries Partnership
TMDL	Total Maximum Daily Load

TSP	Transportation System Plan
UGB	urban growth boundary
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGCRP	United States Global Change Research Program
USGS	United States Geological Survey
v/c	volume-to-capacity
VOC	volatile organic compound
WSDOT	Washington State Department of Transportation

Executive Summary

This environmental impact statement (EIS) evaluates the environmental effects that could occur with construction and implementation of the proposed Tillamook Southern Flow Corridor (SFC) project. The SFC project would include floodplain and wetland restoration actions near the confluence of the Wilson and Trask Rivers in the lower Tillamook Valley. Implementation of this project would reduce flooding in the lower Trask, Tillamook, and Wilson river floodplains, including the U.S. Highway 101 (Highway 101) business corridor in Tillamook, Oregon, and restore tidal marsh habitats along Tillamook Bay. **Figure ES-1** shows the project vicinity.

The U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) proposes to fund the SFC project through FEMA's Public Assistance (PA) grant program. The project proposed by the Port of Tillamook Bay (POTB) and Tillamook County would also receive funding from the National Oceanic and Atmospheric Administration (NOAA) Restoration Center, U.S. Fish and Wildlife Service (USFWS), State of Oregon lottery funds, Oregon Watershed Enhancement Board (OWEB), Tillamook County, and other public and private entities. FEMA is the federal lead agency for the National Environmental Policy Act (NEPA). Cooperating agencies include the NOAA Restoration Center, USFWS, and the U.S. Army Corps of Engineers (USACE). The NOAA Restoration Center and USFWS are the lead agencies for compliance with the Endangered Species Act (ESA).

Flooding occurs frequently in the lower portions of the Wilson, Trask, and Tillamook rivers, typically between October and April. High tides combine with storm surges, heavy rainfall, and snowmelt, causing coastal and inland flooding. The storms that produce coastal flooding often bring heavy rain, which causes high river flows at estuaries and the mouths of rivers. These flows are held back by high ocean levels, creating flood hazards in the Tillamook Valley.

The County suffers significant losses because of disruptions to Highway 101, the major north-south arterial along the Pacific Coast, from flooding. Losses in the past have been primarily economic, but the potential for loss of life exists if the main arterial across the valley is closed due to flooding. The lower portions of the rivers overflow their banks frequently because the channel gradients are low in the delta and estuary areas. In addition, channel capacity is inadequate to handle heavy flows during severe rainstorms, particularly when combined with high tides. Flood losses in Tillamook County exceeded $60 million from 1996 through 2000 and included damages to homes, farmland, businesses, and infrastructure (Tillamook County 2014a). Additional flood losses have been incurred by the Tillamook community since 2000. In response to these frequent flood events, POTB, Tillamook County, the City of Tillamook, several state and federal agencies, non-profit organizations, and local business interests have been working together to identify solutions to Tillamook Valley's ongoing flood problem.

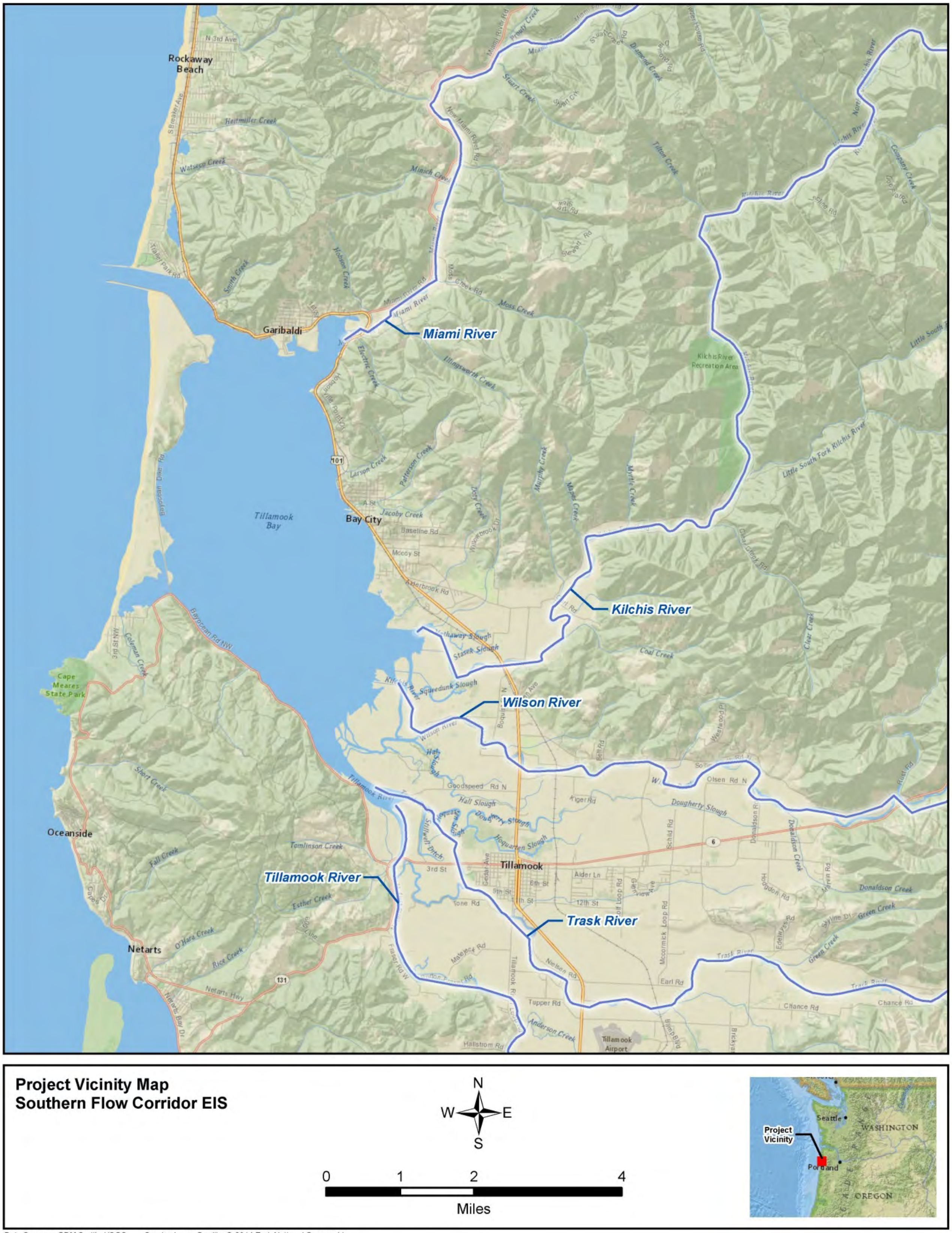


Figure ES-1. Project Vicinity

Without implementation of the SFC project, future unmitigated flooding in the Tillamook Valley would continue to contribute to potential future life safety risks and physical and economic damages to property and businesses in the floodplains. Continued degradation of important fish and wildlife habitats in the estuary through blockages to fish passage, historic losses of aquatic and wetland habitats, and altered sediment erosion and deposition regimes may hamper recovery plans for currently listed species that use the study area and lead to listing of additional species under the ESA.

The objectives for this action are to reduce flood damage in the lower Wilson River floodplain, including portions of Tillamook, Oregon, near the Highway 101 business corridor, and to re-establish a properly functioning and self-sustaining estuarine tidal marsh ecosystem that will provide critical rearing habitat for salmonids and other native fish and wildlife species in the Tillamook Bay estuary.

ES.1 Public Involvement

Public involvement on this project has been ongoing since 2000 when USACE conducted public scoping meetings for a proposed EIS on flood damage reduction and ecosystem restoration alternatives in the Tillamook Valley. The USACE EIS process was never completed, but early public involvement was focused on many of the same areas and concerns as the current studies. Prior public involvement activities also include the extensive outreach conducted as a part of the Oregon Solutions Project initiated in 2007.

A public scoping process as required by 40 Code of Federal Regulations (CFR) 1501.7 was completed for the SFC project. FEMA published a Notice of Intent (NOI) to prepare an EIS in the *Federal Register* on May 6, 2014. The NOI included a description of the project purpose and need and the alternatives and invited the public to attend a public meeting and submit comments on the project. The 30-day scoping period lasted from May 14, 2014 to June 13, 2014. Appendix B contains a copy of the scoping report, including comments received. The scoping report is also available on the project website at http://southernfloweis.org.

FEMA has published a Notice of Availability (NOA) of this Draft EIS to provide the public an opportunity to review and comment on the Draft EIS. A public open house is scheduled to solicit comments from the community about the findings presented in the Draft EIS.

Opportunities to participate in the review process include attendance at the open house and review of the materials online or at several locations where hard copies have been made available. Comments can be made verbally at the public meeting where verbal testimony will be captured by a court reporter, or they can be submitted in a written format. Comments will be collected at the meeting and by mail, email, and fax. All comments received during the 45-day public comment period, along with responses thereto, will be incorporated into the Final EIS. Responses to comments will be published as part of the Final EIS.

ES.2 Alternatives Considered

The project alternatives evaluated in this EIS are described in Section 3 of the EIS and include the No Action Alternative, the Southern Flow Corridor – Landowner Preferred Alternative (Proposed Action), Hall Slough Alternative, and the Southern Flow Corridor – Initial Alternative. The three action alternatives are analyzed at a project level, and the potential direct, indirect, and cumulative impacts are presented for each alternative. **Figure ES-2** shows features of the Proposed Action.

The Southern Flow Corridor – Landowner Preferred Alternative is referred to as Alternative 1 or the Proposed Action. It was designed to remove manmade impediments to flood flows to the maximum extent possible in the lower Wilson and Trask rivers floodplain for both flood hazard mitigation and for habitat restoration. The project would accomplish this by removing existing levees and fills along the edges of the sloughs and rivers that border the project area. New setback levees would be required to protect adjacent private lands. Areas outside the setback levees would be restored to tidal wetlands.

Alternative 2, the Hall Slough Alternative, would reconnect the upper end of Hall Slough to the Wilson River in order to increase the capacity of Hall Slough to carry some floodwaters out to Tillamook Bay. This alternative was designed to focus on the area near where the Wilson River overtops first during a flood event, frequently inundating Highway 101. Levees along Hall Slough would be set back or modified, and a portion of the channel would be widened and deepened.

Alternative 3, the Southern Flow Corridor – Initial Alternative, shares a number of characteristics in common with the Proposed Action although it features somewhat different levee, floodgate, and drainage network configurations. This alternative would also function in a similar fashion to the Proposed Action in that it would also remove manmade impediments to flood flows in the lower Wilson River floodplain and restore tidal wetlands and channels.

ES.3 Scope of EIS

Selection of topics to be addressed in the EIS was based on concerns raised during public scoping (see Section 1.5 of the Draft EIS) and on regulatory and FEMA policy requirements. These issues involve resources that could be beneficially or adversely affected by the action alternatives. As described in this EIS, the action alternatives are generally expected to have some adverse construction-related, short-term, and/or localized effects, but the long-term effects are expected to be beneficial for most resource areas evaluated.

Resource topics evaluated include the following:

- Construction Impacts
    a. Noise
    b. Traffic
- Water Resources
    a. Floodplains
    b. Wetlands
    c. Hydrology
    d. Water Quality
    e. Groundwater Resources

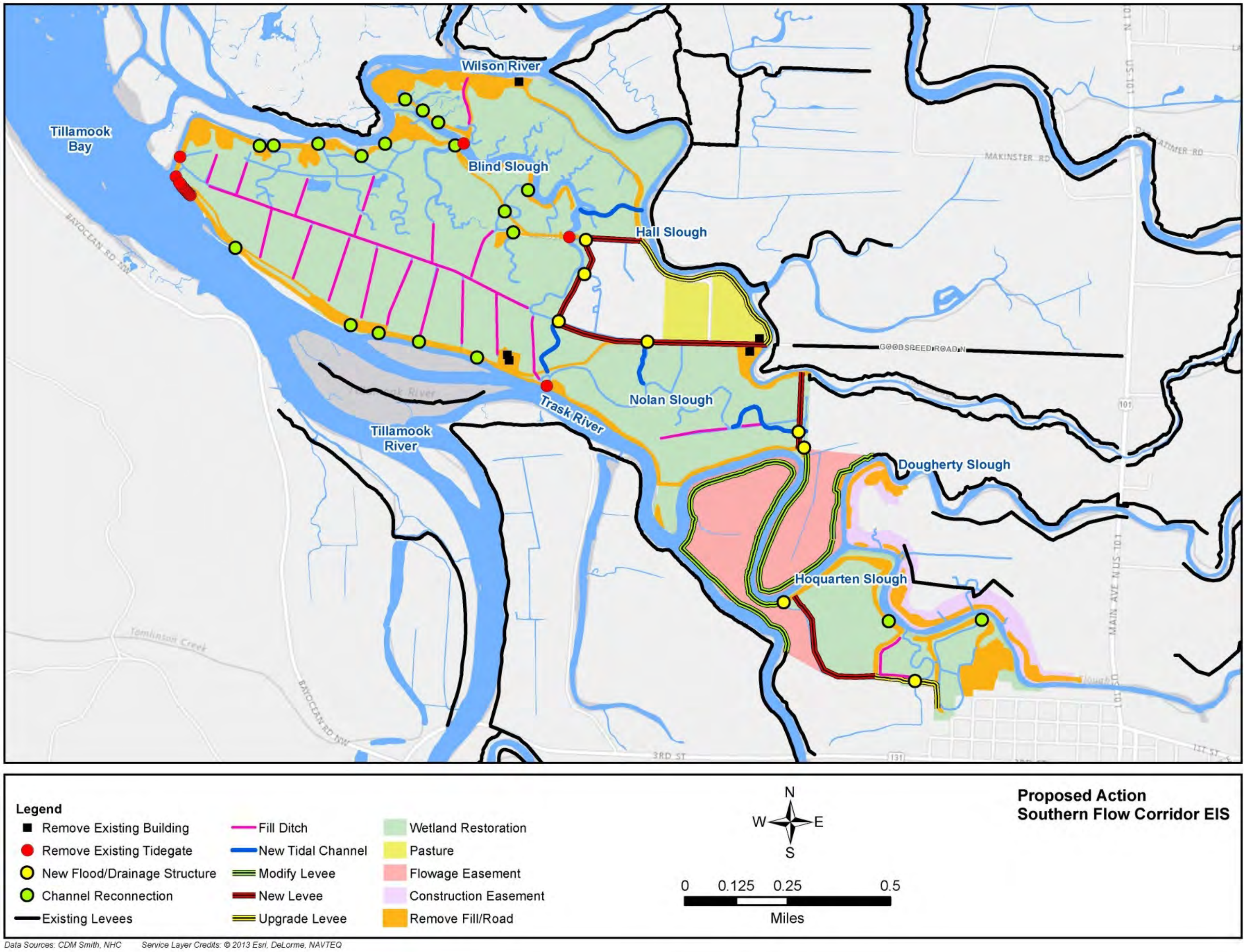


Figure ES-2. Proposed Action

- Biological Resources
    a. Vegetation
    b. Fish and Wildlife
    c. Threatened and Endangered Species
- Physical Resources
    a. Geology and Soils
    b. Coastal Resources
    c. Air Quality
    d. Climate Change
    e. Hazardous Materials
    f. Visual Quality and Aesthetics
- Cultural Resources
- Socioeconomics
    a. Regional Economics
    b. Environmental Justice
    c. Public Health and Safety
    d. Recreation

The NEPA review of the alternatives and the final decision must be conducted within the framework of numerous laws, regulations, and executive orders. Some of these authorities pertain directly to FEMA grant funding authorities. Others establish regulatory compliance standards for environmental resources or provide guidance for management of environmental resources (e.g., ESA for the protection of threatened and endangered species). Construction and implementation of the Proposed Action could have effects on cultural resources, water resources, fish and wildlife and their habitats, or on the agricultural economy of the Tillamook area. Applicable regulations that guide the evaluation for each of these resource categories are described in the appropriate subsections of Section 4 and in Appendix C.

ES.4 Summary of Potential Effects

Table ES-1 summarizes the conclusions of the EIS regarding the environmental effects of the No Action Alternative and each action alternative. Proposed mitigation measures are listed in Section 6 of the EIS.

The overall effects of the action alternatives would be beneficial. The Proposed Action would restore approximately 522 acres of tidal wetlands and associated fish and wildlife habitat. The Proposed Action would have major long-term beneficial effects on wildlife and threatened and endangered species, including the threatened Coastal coho salmon. The Proposed Action would reduce flooding during small flood events as well as the 100-year flood.

The Hall Slough Alternative would restore up to 90 acres of riparian flow-through and tidal wetlands and associated vegetation but would not be as beneficial to wildlife and threatened and endangered species as the Proposed Action. The Hall Slough Alternative would reduce damages related to small annual floods but would not provide flood hazard reduction for larger floods.

The Initial Alternative would restore 568 acres of tidal wetland and associated fish and wildlife habitat and would have similar benefits and impacts as the Proposed Action. The flood-reduction benefits of the Initial Alternative would not be as great as the Proposed Action.

The Proposed Action would have unavoidable impacts that would remain despite mitigation. Construction activities in the southeastern portion of the project area would be adjacent to a sensitive receptor, the Tillamook Regional Medical Center, and would result in adverse noise impacts.

Under the Proposed Action, there would be a conversion of freshwater wetlands to tidal wetlands. There would be short-term, construction-related impacts due to the removal of vegetation, including native vegetation associated with the existing freshwater wetlands and riparian vegetation along channels where levees would be removed or modified. Over the long term, there would be a net increase in wetland functions and acres.

Because of the amount of fill that would be distributed on the floodplain under the Proposed Action, there is a major potential for erosion to create adverse impacts on water quality through increased turbidity. Turbidity could remain elevated during a transition period of several years while the existing vegetation transitions to emergent tidal marsh communities. Best management practices and careful construction sequencing would be used to reduce this effect where possible.

Although extensive mitigation measures would be implemented to protect wildlife, some wildlife would inevitably be harmed during construction. Some individuals may be displaced by construction activity, and noise and habitat for terrestrial and freshwater aquatic species would be reduced following construction. Removal of fish from the work zone, and potentially fish handling, which can result in inadvertent mortality, could occur during construction. The threatened Oregon Coastal coho salmon could be adversely affected through the mechanisms that would affect fish during construction. Nesting habitat for the threatened Marbled murrelet could be adversely affected by the loss of large diameter Sitka spruce along levees in the project area; although, that habitat impact would be offset by improvement in foraging habitat.

Farmland of statewide importance would be converted to tidal wetlands under the action alternatives although this is considered an indirect conversion because the land would not be developed.

During construction, visual contrast would be unavoidably increased as levees and their associated vegetation is removed. This contrast would be visible from few viewpoints and would decrease over time as tidal wetlands become vegetated and blend with adjacent tidal habitats.

Many potential effects would not be significant with the implementation of best management practices (BMPs) or mitigation measures. The proposed BMPs and mitigation measures are listed in Section 6 of the Draft EIS. Most of the mitigation measures would apply to all of the alternatives. Because the Hall Slough Alternative would include dredging, additional mitigation measures would be required to reduce the adverse impacts of dredging Hall Slough.

Table ES-1. Summary of Potential Effects

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Construction Impacts				
Noise	No effect	Moderate, local, adverse impact from short-term, intermittent noise during construction at one sensitive receptor; impacts would be significant and unavoidable at the sensitive receptor. Transition-period and long-term impacts would be minor, local, adverse, and less than significant.	Moderate, local, adverse impact from short-term, intermittent noise during construction would be less than significant. Minor, local, adverse impact from maintenance dredging would be less than significant. Transition-period and long-term impacts would be minor, local, adverse, and less than significant.	Moderate, local, adverse impact from short-term, intermittent noise during construction at one sensitive receptor; impacts would be significant and unavoidable at the sensitive receptor. Transition-period and long-term impacts would be minor, local, adverse, and less than significant.
Traffic	No effect	Minor, local, adverse impacts from temporary increases in construction-related traffic on Highway 101, Goodspeed Road, and OR 131 would be less than significant. No transition period or long-term effects.	Minor, local, adverse impacts from temporary increases in construction-related traffic on Highway 101 and Wilson River Loop would be less than significant. No transition period or long-term effects.	Minor, local, adverse impacts from temporary increases in construction-related traffic on Highway 101, Goodspeed Road, and OR 131 would be less than significant. No transition period or long-term effects.
Water Resources				
Floodplains	Major, local, adverse short- and long-term impacts on floodplain functions would be significant. Moderate, regional, adverse short- and long-term impacts on floodplain functions would be significant.	Moderate, local, adverse construction-related and transition-period impacts would be less than significant. Moderate, regional, beneficial long-term effect on flood elevations. Major, local, beneficial long-term effect on floodplain functions.	Moderate, local, adverse construction-related and transition-period impacts would be less than significant. Minor, local, beneficial long-term effect on flood elevations. Minor, regional, beneficial long-term effect on floodplain functions.	Moderate, local, adverse construction-related and transition-period impacts would be less than significant. Moderate, regional, beneficial long-term effect on flood elevations. Major, local, beneficial long-term effect on floodplain functions.

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Wetlands	Moderate, local, short-term beneficial effects on wetlands. Major regional, long-term adverse impacts from continued degraded functional conditions would be significant.	Moderate, local, construction-related adverse impacts would be less than significant. Major, local, transition period adverse impacts on freshwater wetlands would not be significant. Major, local and regional, long-term beneficial effects on wetland function and area with the restoration of 522 acres of tidal wetland.	Minor, local, construction-related and transition period adverse impacts would be less than significant. Moderate, local, long-term beneficial effects on wetland function and area with the restoration of 90 acres of riparian flow-through and tidal wetlands between the new setback levees along the Hall Slough channel.	Moderate, local, construction-related adverse impacts would be less than significant. Major, local, transition period adverse impacts on freshwater wetlands would not be significant. Major, local and regional, long-term beneficial effects on wetland function and area with the restoration of 568 acres of tidal wetland.
Hydrology	Major, local, short- and long-term adverse impacts on hydrology from continued flooding would be significant.	Minor, local, adverse construction-related effects on hydrology would be less than significant. Major, regional, short- and long-term beneficial effects on hydrology.	Moderate, local, adverse construction-related effects on hydrology due to dredging would be significant. Minor, local adverse transition-period impacts would be less than significant. Minor, regional long-term beneficial effects on hydrology.	Minor, local, adverse construction-related effects on hydrology would be less than significant. Major, regional, short- and long-term beneficial effects on hydrology.
Water Quality	Minor, local, short- and long-term beneficial effects from the passive conversion from agricultural use to freshwater wetlands. Moderate, local, long-term adverse impact from the contaminated materials on the Sadri property would be significant.	Moderate, local, adverse construction-related and transition-period impacts due to turbidity in surface waters could potentially occur; however, with implementation of BMPs and mitigation measures, most impacts would be minor and less than significant. Some unavoidable, adverse, short-term impacts from turbidity and sedimentation would remain during the transition period. Moderate, regional, long-term beneficial effects on water quality.	Moderate, local, adverse impacts due to turbidity in surface waters during construction and periodic maintenance dredging would be less than significant. Moderate, local, transition period and long-term beneficial effects on water quality due to increased floodplain connectivity, riparian shade, and filtration by wetland vegetation. Moderate, local, long-term adverse impact from the contaminated materials on the Sadri property would be significant.	Moderate, local, adverse construction-related and transition-period impacts due to turbidity in surface waters could potentially occur; however with implementation of BMPs and mitigation measures, most impacts would be minor and less than significant. Some unavoidable, adverse, short-term impacts from turbidity and sedimentation would remain during the transition period. Moderate, regional, long-term beneficial effects on water quality.

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Groundwater Resources	Minor, local, short- and long-term beneficial effects.	Negligible, local, adverse construction-related impacts would be less than significant. Minor, local, long-term groundwater quality benefits due to discontinued use of two septic systems in project area.	Negligible, local, adverse construction-related impacts would be less than significant. Minor, local, short- and long-term beneficial effects.	Negligible, local, adverse construction-related impacts would be less than significant. Minor, local, long-term groundwater quality benefits due to discontinued use of one septic system in project area.
Biological Resources				
Vegetation	No construction impacts. Minor, local, long-term, beneficial effects from the transition to freshwater wetlands.	Moderate, local, adverse construction-related and short-term impacts from the removal of Sitka spruce trees and loss of riparian vegetation. This impact would not be considered significant because the alternative would transition to the native, historical vegetation condition. Major, local and regional, long-term beneficial effects from the restoration of 522 acres of tidal marsh vegetation.	Minor, local, adverse, construction-related impacts from the removal of riparian vegetation along Hall Slough. Moderate, local, transition period and long-term beneficial effects from the restoration of up to 90 acres of riparian and tidal wetlands and conversion of pasture to freshwater wetlands on County land in the SFC area.	Moderate, local, adverse construction-related and short-term impacts from the removal of Sitka spruce trees and loss of riparian vegetation. This impact would not be considered significant because the alternative would transition to the native, historical vegetation condition. Major, local and regional, long-term beneficial effects from the restoration of 568 acres of tidal marsh vegetation.

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Fish and Wildlife	Moderate, regional, long-term adverse impacts related to continued reductions in floodplain connectivity and potential rearing habitat for anadromous and migratory fish species would be significant. Continued sediment accumulation within channels located inside the diked portion of the study area.	Moderate, local, adverse impacts to terrestrial wildlife and major adverse impacts to aquatic wildlife during construction and in the short term would not be significant with use of BMPs and other mitigation measures. Major, local and regional, long-term, beneficial effects on fish and wildlife would be expected, including beneficial effects from: • Expansion of floodplain connectivity • Increased aquatic cover and habitat complexity for juvenile salmonids, forage fish, juvenile marine fish, and bay residents • Increased use by shorebirds and wading birds and foraging opportunities for migratory and wintering waterfowl • Increased productivity in the Tillamook Bay ecosystem as a whole with the expansion in estuarine habitat, leading to increased fish, bird, and invertebrate abundance and increases in habitat and foraging opportunities	Moderate, local, adverse impacts on fish and wildlife during construction as vegetation becomes re-established would be less than significant. Moderate, local, beneficial effects during the transition period. Moderate, local and regional, long-term beneficial effects to fish and wildlife habitat from the restoration of riverine flow-through wetlands along the banks of Hall Slough. Periodic, minor, local, short-term, adverse impacts from maintenance dredging would not be significant with the use of BMPs.	Moderate, local, adverse impacts to terrestrial wildlife and major adverse impacts to aquatic wildlife during construction and in the short term would not be significant with use of BMPs and other mitigation measures. Major, local and regional, long-term, beneficial effects on fish and wildlife would be expected, including beneficial effects from: • Expansion of floodplain connectivity • Increased aquatic cover and habitat complexity for juvenile salmonids, forage fish, juvenile marine fish, and bay residents • Increased use by shorebirds and wading birds and foraging opportunities for migratory and wintering waterfowl • Increased productivity in the Tillamook Bay ecosystem as a whole with the expansion in estuarine habitat, leading to increased fish, bird, and invertebrate abundance and increases in habitat and foraging opportunities

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Threatened and Endangered Species and Critical Habitat	Moderate, regional, long-term adverse impacts related to the continued degradation of designated critical habitat for coho salmon would be significant. Potential nesting habitat for Marbled murrelet would remain, and trees with suitable structure could improve with age.	Moderate, local, adverse impacts on coho salmon during construction not significant with use of BMPs and mitigation measures. Major, regional, long-term, beneficial effects on coho salmon and critical habitat for coho, including an increase in aquatic habitats, productivity, foraging, and refuge. Moderate adverse impact related to the loss of potential Marbled murrelet nesting trees in both the short and long term; however, a moderate, regional, long-term, beneficial effect from an increase in foraging habitat would result in a net beneficial effect on the species.	Moderate, local, adverse impacts on coho salmon during construction would not be significant with the use of BMPs and mitigation measures. Minor long-term beneficial effects on coho salmon and critical habitat for coho because additional rearing habitat would be created. Periodic, minor, local, short-term, adverse impacts from maintenance dredging would not be significant with the use of BMPs. No effect on Marbled murrelet because there would be no loss of potential nesting trees.	Moderate, local, adverse impacts on coho salmon during construction not significant with use of BMPs and mitigation measures. Major, regional, long-term beneficial effects on coho salmon and critical habitat for coho, including an increase in aquatic habitats, productivity, foraging, and refuge. Moderate adverse impact related to the loss of potential Marbled murrelet nesting trees in both the short and long term; however, a moderate, regional, long-term, beneficial effect from an increase in foraging habitat would result in a net beneficial effect on the species.
Physical Resources				
Geology and Soils – Seismic	No effect	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.
Geology and Soils – Fluvial Geomorphology	Moderate, regional, adverse, long-term impacts on fluvial geomorphology from continued disruption of natural fluvial processes would be less than significant.	Major, local, adverse impacts during construction and in the short term from soil erosion could potentially occur; however, with implementation of BMPs and mitigation measures, impacts would be moderate and less than significant. Minor, local, long-term adverse impacts would be less than significant, with some beneficial aspects of more natural channel formation.	Major, local, adverse impacts during construction and in the short term from soil erosion could potentially occur; however, with implementation of BMPs and mitigation measures, impacts would be moderate and less than significant. Minor, local, long-term adverse impacts would be less than significant, with some beneficial aspects of more natural channel formation.	Major, local, adverse impacts during construction and in the short term from soil erosion could potentially occur; however, with implementation of BMPs and mitigation measures, impacts would be moderate and less than significant. Minor, local, long-term adverse impacts would be less than significant, with some beneficial aspects of more natural channel formation.

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Geology and Soils – Farmland Protection	No effect	Minor, local, adverse long-term impact from the indirect conversion of 353 acres (320 acres currently farmed) of farmland of statewide importance to wetlands would be less than significant.	Minor, local, adverse long-term impact from the indirect conversion of 86 acres of farmland of statewide importance would be less than significant.	Minor, local, adverse long-term impact from the indirect conversion of 393 acres (260 acres currently farmed) of farmland of statewide importance to wetlands would be less than significant.
Coastal Resources	No adverse effects related to compliance with the Coastal Zone Management Act (CZMA). Moderate, regional, long-term significant impact from not meeting the goals of the County Comprehensive Plan or the state planning goals.	No adverse effects related to compliance with CZMA. Major, regional, long-term beneficial effects from restoration of tidal marsh ecosystem.	No adverse effects related to compliance with CZMA. Moderate, regional, long-term beneficial effects from restoration of riparian and tidal wetlands along Hall Slough.	No adverse effects related to compliance with CZMA. Major, regional, long-term beneficial effects from restoration of tidal marsh ecosystem.
Air Quality	No effect	Minor, local, adverse impacts during construction would be less than significant. No transition period or long-term impacts.	Minor, local, adverse impacts during construction would be less than significant. No transition period or long-term impacts.	Minor, local, adverse impacts during construction would be less than significant. No transition period or long-term impacts.

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Climate Change	No impacts on climate change. Minor, local, adverse short-term impacts from climate change would be less than significant. Potential moderate to major, regional, long-term adverse effects from climate change could be significant.	Minor, regional, adverse impact of project construction on climate change would be less than significant. Moderate, regional, transition period and long-term beneficial effects on climate change from the restored floodplain, which may help the community to adapt to sea level rise that would occur from climate change. Minor, regional, short- and long-term beneficial effects against impacts from climate change.	Minor, regional, adverse impact of project construction on climate change would be less than significant. Moderate, regional, transition period and long-term beneficial effects on climate change from restored Hall Slough channel, which may help the community to adapt to sea level rise that would occur from climate change. Minor, regional, short- and long-term beneficial effects against impacts from climate change.	Minor, regional, adverse impact of project construction on climate change would be less than significant. Moderate, regional, transition period and long-term beneficial effects on climate change from the restored floodplain, which may help the community to adapt to sea level rise that would occur from climate change. Minor, regional, short- and long-term beneficial effects against impacts from climate change.
Hazardous Materials	Moderate, local, long-term adverse impact from the potential for release of contaminants from the Sadri property would be significant.	Moderate, local, adverse impacts during construction at the Sadri property could potentially occur; however, impacts would be minor and less than significant after implementation of BMPs and mitigation measures. Minor, local, transition period and long-term adverse impacts from the potential for release of hazardous materials from heavy equipment used for maintenance activities would be less than significant.	Minor, local, adverse impacts during construction, transition period, and long term from the potential for release of hazardous materials from heavy equipment used for construction and maintenance activities would be less than significant.	Moderate, local, adverse impacts during construction at the Sadri property could potentially occur; however, impacts would be minor and less than significant after implementation of BMPs and mitigation measures. Minor, local, transition period and long-term adverse impacts from the potential for release of hazardous materials from heavy equipment used for maintenance activities would be less than significant.
Visual Quality and Aesthetics	Generally no effect. Major flooding has potential to result in major, local, adverse short-term impacts that would be significant.	Moderate to major, local, adverse construction and transition-period impacts would be significant. Minor to moderate, local, adverse long-term impact related to tree removal would be less than significant.	Moderate to major, local, adverse construction and transition-period impacts would be significant. Minor to moderate, local, adverse long-term impact related to tree removal would be less than significant.	Moderate to major, local, adverse construction and transition-period impacts would be significant. Minor to moderate, local, adverse long-term impact related to tree removal would be less than significant.

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Cultural Resources				
Cultural Resources	No effect	Minor, local, adverse impacts due to a low potential to encounter cultural resources during construction; with implementation of mitigation measures, impacts would be less than significant. No transition period or long-term impacts.	Minor, local, adverse impacts due to a low potential to encounter cultural resources during construction; with implementation of mitigation measures, impacts would be less than significant. No transition period or long-term impacts.	Minor, local, adverse impacts due to a low potential to encounter cultural resources during construction; with implementation of mitigation measures, impacts would be less than significant. No transition period or long-term impacts.
Socioeconomics				
Economics	Generally no effect; however, flooding has potential for major, regional, adverse long-term economic impacts that would be significant.	Minor to moderate, regional, temporary beneficial effects to the economy during construction. Moderate to major, regional, transition-period and long-term beneficial effects from the reduced potential for flooding, including reduced flood impacts on adjacent farmlands. Major, regional, long-term benefit to coastal fisheries. Negligible, regional, long-term adverse impact related to conversion of farmland would be less than significant.	Minor to moderate, regional, temporary beneficial effects to the economy during construction. Minor, regional, transition-period and long-term beneficial effects from the reduced potential for flooding. Negligible, regional, long-term adverse impact related to conversion of farmland would be less than significant.	Minor to moderate regional temporary beneficial effects to the economy during construction. Moderate to major regional, transition-period and long-term beneficial effects from the reduced potential for flooding, including reduced flood impacts on adjacent farmlands. Major regional long-term benefit to coastal fisheries. Negligible regional long-term adverse impact related to conversion of farmland would be less than significant.
Environmental Justice	Generally no effect; however, flooding has potential for major, local, adverse impacts.	No adverse impacts during construction. Major, regional, long-term beneficial effects related to reduced flooding.	No adverse impacts during construction. Moderate, regional, long-term beneficial effects related to reduced flooding.	No adverse impacts during construction. Major, regional, long-term beneficial effects related to reduced flooding.

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Public Health and Safety	Major, local, adverse impacts related to continued potential for disruption of public services and increased demand for public safety services during floods would be significant.	Major, local, adverse construction-period impacts to safety could be occur; however, with implementation of mitigation measures, impacts would be minor and less than significant. No effect on emergency services. Long-term, local, beneficial effects from reduced flooding risk and decrease in manure application. Minor, local, long-term impacts from increased mosquitos although more study is needed to verify; this would be less than significant.	No effect on emergency services. Major, local, adverse construction period impacts to safety would be significant; with implementation of mitigation measures, impacts would be minor and less than significant. Long-term beneficial effects from reduced flooding risk.	Major, local, adverse construction-period impacts to safety could occur; however, with implementation of mitigation measures, impacts would be minor and less than significant. No effect on emergency services. Long-term, local, beneficial effects from reduced flooding risk and decrease in manure application. Minor, local, long-term impacts from increased mosquitos although more study is needed to verify; this would be less than significant.
Recreation	Moderate, local, adverse impacts on populations of recreational fish and shellfish would be significant. Minor, local, beneficial effect from the limited recreational access.	Minor, local, adverse impacts related to closure of recreational areas during construction would be less than significant. Minor, local, adverse impacts on fishing during construction would be less than significant. Moderate to major short- and long-term beneficial effects on recreational fish and shellfish populations.	Minor, local, adverse impacts related to closure of recreational areas during construction would be less than significant. Minor, local, adverse impacts on fishing during construction would be less than significant. Moderate short- and long-term beneficial effects on recreational fish and shellfish populations.	Minor, local, adverse impacts related to closure of recreational areas during construction would be less than significant. Minor, local, adverse impacts on fishing during construction would be less than significant. Moderate to major short- and long-term beneficial effects on recreational fish and shellfish populations.

SECTION 1 Introduction

The U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) proposes to fund the project known as the Southern Flow Corridor (SFC) project through FEMA's Public Assistance (PA) grant program. The project proposed by the Port of Tillamook Bay (POTB) and Tillamook County would also receive funding from the National Oceanic and Atmospheric Administration (NOAA) Restoration Center, U.S. Fish and Wildlife Service (USFWS), State of Oregon lottery funds, Oregon Watershed Enhancement Board (OWEB), Tillamook County, and other public and private entities. The project is intended to reduce flood damage in the Tillamook Valley and restore habitat in the Tillamook Bay estuary.

FEMA received a PA application from POTB for the SFC project as an alternate project to the repair of its rail line damaged by flooding and severe storms in December 2007. Agencies may propose an "alternate" project for disaster recovery funding if the public welfare would be better served by an action other than restoration of the damaged facilities to their pre-disaster design. POTB has proposed that the public welfare would be better served by funding a hazard mitigation project to reduce flood damage rather than repairing a rail line that no longer serves a significant public function. FEMA's Proposed Action is to provide funding for the project as authorized under Section 406 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93–288, as amended.

The SFC project would include floodplain and wetland restoration actions near the confluence of the Wilson and Trask Rivers. This would reduce flooding in the lower Trask, Tillamook, and Wilson river floodplains, including the U.S. Highway 101 (Highway 101) business corridor in Tillamook, Oregon, and restore tidal marsh habitats along the Bay. The SFC project was one of a suite of potential projects developed over the past two decades to address flooding in the Tillamook Valley.

This draft environmental impact statement (EIS) evaluates the environmental effects that could occur if the SFC project or other project alternatives are implemented. This EIS has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, the President's Council on Environmental Quality (CEQ) regulations to implement NEPA (40 Code of Federal Regulations [CFR] Parts 1500-1508), and FEMA's regulations implementing NEPA (44 CFR Part 10).

This section of the EIS describes the project area and background as it relates to flooding and ecosystem decline; the roles, responsibilities, and authorities of FEMA and the other federal cooperating agencies involved in this project; the scope of the EIS; and the public involvement process completed prior to and during the preparation of this Draft EIS.

1.1 Background

Tillamook County is about 1,100 square miles with a population of just over 25,000 in 2010 (U.S. Census Bureau 2014). The relatively small Tillamook Valley is hemmed in by the Coast Range to the east and headlands, low hills, and sandy beaches and marshes to the west (**Figure 1-1**). The slopes of the Coast Range climb up to 3,500 feet (1,064 meters [m]) above sea level. The valley bottom is composed of deep floodplain soils that are used for hay and pasture and support the dairy industry, which is a major component of Tillamook's economy. Other important elements of the local economy are tourism and fishing. Tourists are drawn to the dramatic Oregon coastline and sandy beaches. Both commercial and recreational fisheries rely on salmon and other Pacific Ocean species found in the estuary or the open ocean, which is readily accessible from Tillamook. Tillamook Bay has been designated as a significant tidal estuary under the National Estuary Program, and the area is a component of the Oregon Coastal Salmon Restoration Initiative (U.S. Army Corps of Engineers [USACE] 2005).

Five major rivers enter the Tillamook Bay estuary, which includes the mouths of the Miami, Kilchis, Wilson, Trask, and Tillamook rivers (**Figure 1-1**). The rivers originate in the Coast Range, cutting through steep uplands to drain into the alluvial plain and estuary below. The Wilson, Trask, and Tillamook rivers merge to form a broad alluvial plain to the east and south of the Bay on which the City of Tillamook is located. The Miami and Kilchis rivers have similar watersheds and characteristics as the Wilson and Trask, but they are smaller and are located in sparsely populated areas north of Tillamook. The Tillamook River also drains a relatively small area, similar to the Miami and Kilchis rivers. All of these rivers flow into the southern end of Tillamook Bay except for the Miami River, which flows into the bay at its northern end (**Figure 1-2**). The total watershed area of the five rivers is approximately 600 square miles. The Wilson and Trask rivers are the two basins most responsible for flooding affecting the Tillamook Valley and the City of Tillamook.

Two issues of long-standing interest to the local community are the management of natural resources in the estuary, such as fish and shellfish, and flood hazard reduction in the lower Tillamook Valley. In 1992, the Tillamook Bay and estuary were approved into the National Estuary Program (NEP), which is a federal program under the Clean Water Act (CWA) that helps communities protect and restore the health of estuaries while supporting economic and recreational activities. Under the auspices of the NEP, the local community and state and federal agencies developed the Tillamook Bay Comprehensive Conservation and Management Plan. That plan identified four key priorities for action, including restoration of key habitats, protection of water quality, control of erosion and sedimentation, and reduction of flooding. These same issues continue to be priorities today. The following sections provide additional background on the issues of flooding and habitat degradation in the Tillamook Valley and Tillamook estuary.

1.1.1 Climate and Floods

The climate of Tillamook is determined by its position directly west of the Coast Range mountains. As offshore storms rise over the mountains, they release significant amounts of precipitation, with locations at the top of the Coast Range receiving over 200 inches of precipitation per year. Most of the precipitation falls as rain and most falls between the months of October and March. Locations in the lowlands receive significant rainfall as well, averaging approximately 100 inches per year.

Flooding occurs frequently in the lower portions of the Wilson, Trask, and Tillamook Rivers, typically between October and April. High tides combine with storm surges, heavy rainfall, and snowmelt, causing coastal and inland flooding. The storms that produce coastal flooding often bring heavy rain, which causes high river flows at estuaries and the mouths of rivers. These flows are held back by high ocean levels, creating flood hazards.

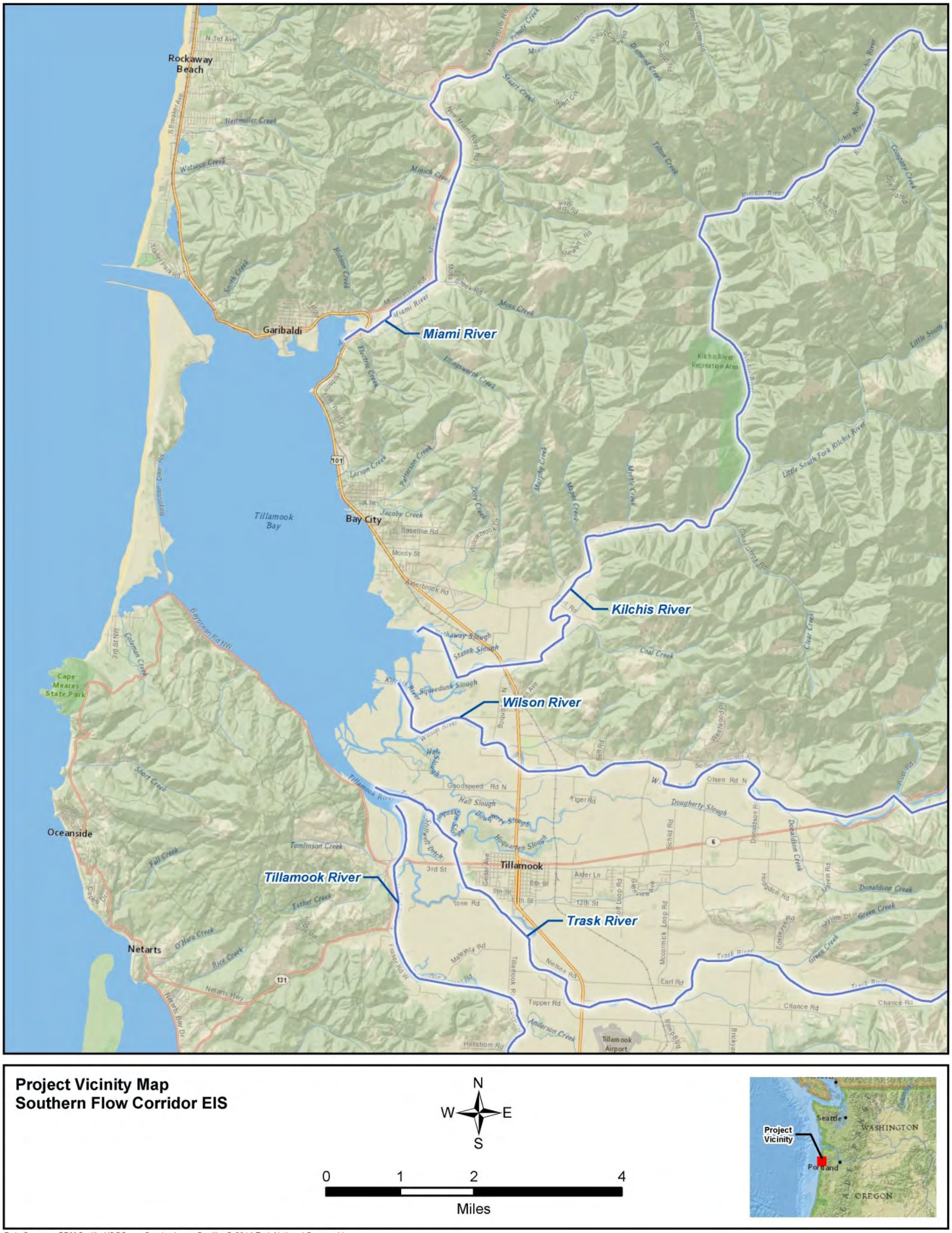
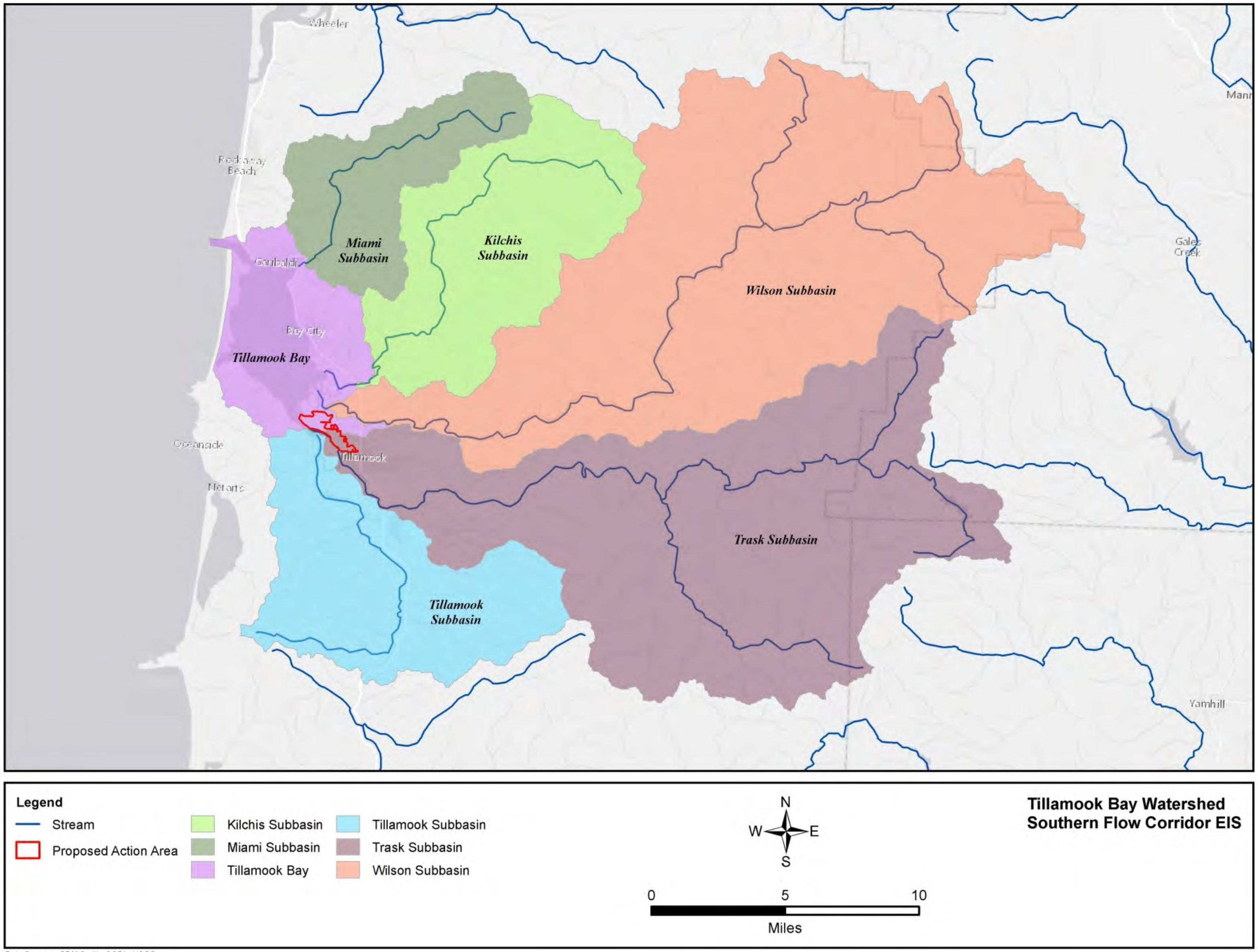


Figure 1-1. Project Vicinity



Data Sources: CDM Smith, OSDL, USGS

Figure 1-2. Tillamook Watershed Subbasins

Most rivers in Tillamook County rise to flood stage or above at least once each winter. The Wilson and Trask Rivers are the two largest rivers that flow into Tillamook Bay (**Figure 1-2**) and produce the largest floods. The Wilson River has reached flood stage (approximately 14,100 cubic feet per second [cfs]) numerous times over the past 32 years; it has exceeded flood stage approximately 60 times, averaging almost two floods per year in the recent past (USACE 2005). Major river flooding occurred in 1916, 1921, 1931, 1949, 1964, 1965, 1972, 1974, 1975, 1996, 2006, and 2007. Major coastal flooding occurred in 1939, 1967, 1976, 1990, 1992, 1996, and 1999 (Oregon Department of Land Conservation and Development [DLCD] 2014).

The County suffers significant losses because of the disruption caused to Highway 101, the major north-south arterial along the Pacific Coast. Losses in the past have been primarily economic, but the potential for loss of life exists if the main arterial across the valley is closed due to flooding. The lower portions of the rivers overflow their banks frequently because the channel gradients are low in the delta and estuary areas. In addition, channel capacity is inadequate to handle heavy flows during severe rainstorms, particularly when combined with high tides. Flood losses in Tillamook County exceeded $60 million from 1996 through 2000 and included damages to homes, farmland, businesses, and infrastructure (Tillamook County 2014a). Additional flood losses have been incurred by the Tillamook community since 2000.

The Wilson River stream gage is operated by the U.S. Geological Survey (USGS) and is located 6 miles east of Tillamook at river mile 9.3. This stream gage has collected flow data at this site since 1930 (USGS 2014a). There is another stream gage on the Trask River, but it has only collected information since 1996. **Table 1-1** shows the nine largest flood events in the Tillamook Valley as based on Wilson River stream gage heights (USGS 2014a). **Figure 1-3** shows flooding in the City of Tillamook and in the proposed project area during November 1999, which was an approximate 5-year flood event (Northwest Hydraulic Consultants [NHC] 2011).

Table 1-1. Wilson River Gage Heights Six Miles East of Tillamook

Date	River Gage Elevation (ft)[1]	Disaster Declaration
12/22/1964	20.26	DR-184
1/20/1972	16.91	DR-319
12/13/1977	16.83	Not declared
12/04/1989	16.67	DR-853 [2]
2/08/1996	19.51	DR-1099
12/27/1998	19.59	Not declared
11/25/1999	17.06	Not declared
11/06/2006	22.89	DR-1672
12/03/2007	20.37	DR-1733
1/21/2012	unknown	DR-4055 [3]

Sources: FEMA 2014a, USGS 2014b

Notes: 1 - River gage elevation is the height of the water surface, in feet, above an established altitude where the stage at this stream gage is set by the USGS at zero.

2 - The river gage height shown was recorded one month before the January 1990 floods that resulted in the disaster declaration DR-853.

3 - The 2012 disaster declaration for Tillamook County did not result from significant flooding in the valley.

River gage height is an indicator of flood severity, and more severe floods result in greater property damages and lengthier road closures. At a reading of above 17.0 feet at the Wilson River gage, residents can expect widespread and significant flooding along the Wilson River and nearby sloughs, including portions of Highway 101 north of downtown Tillamook (National Weather Service 2014). A relatively low stream gage reading may still result in flood damages in the valley if the river crest occurs simultaneously with very high tides.

1.1.2 Flood Hazard Reduction Efforts

In response to these frequent flood events, POTB, Tillamook County, the City of Tillamook, several state and federal agencies, non-profit organizations, and local business interests have been working together to identify solutions to Tillamook Valley's ongoing flood problem. **Table 1-2** presents a timeline of past investigations, studies, and collaborative evaluations of potential flood reduction actions that led to the designation of flooding in central Tillamook County as an Oregon Solutions project[1] by the Governor of Oregon. As an outcome of that Oregon Solutions effort, the Tillamook Bay SFC project was developed.

FEMA's engagement in the ongoing flood problem and the SFC project stems from a December 2007 flood event that resulted in damage across the Tillamook Valley, including severe damage to a historic railroad owned by POTB. In response to this flood damage, POTB applied for disaster recovery funding. FEMA completed Project Worksheet (PW) 936 that identified $49,552,050 in necessary repairs to return the railroad to its pre-disaster condition. Following completion of PW 936, POTB determined that a series of alternate projects would better serve the public welfare in-lieu of repairing the railroad because the rail line no longer served a significant public function. In 2013, FEMA reviewed the proposed Southern Flow Corridor – Landowner Preferred Alternative, which was one of several projects identified by POTB. FEMA determined the Southern Flow Corridor – Landowner Preferred Alternative met the eligibility criteria of cost effectiveness and meeting the public interest (FEMA 2013). That determination allowed the proposed project to move into the next phase, which is the evaluation of potential environmental and historic effects described in this EIS.

Table 1-2 details other flood reduction projects in addition to the development of the SFC project. For example, in September 2008, a gated spillway was constructed in the levee near the confluence of the Wilson and Trask rivers on County-owned land (Levesque 2013). Since 2008, there have been no peak flows on the Wilson River greater than those shown in **Table 1-1** as measured at the stream gage (USGS 2014b). Peak flows on the Wilson River since 2008 have been lower than the flows associated with the 1999 flood shown in **Figure 1-3,** which was an approximate 5-year flood. (**Figure 1-5** also shows flooding in the valley from the 1999 event.)

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[1] *The Oregon Solutions Program is a community governance program initiated by the Oregon Sustainability Act of 2001 housed in the Portland State University National Policy Consensus Center. The Oregon Solutions Program "brings representatives from the business, nonprofit, and civic sector to make commitments, take on specific roles and responsibilities, leverage and pool resources, [and solve problems]."(Oregon Solutions 2014)*

Figure 1-3. Flooding in Tillamook in November 1999

Table 1-2. Timeline of Tillamook Valley Flood Protection Investigations and Actions

Year	Event
1994	Tillamook Bay enters National Estuary Program.
Jun 1999	Tillamook County Creamery Association authorizes acquisition efforts for 375 acres of intertidal wetland.
Jul 1999	USACE and Tillamook County Soil and Water Conservation District execute Feasibility Cost Sharing Agreement.
Aug 1999	USACE completes Reconnaissance Study of Tillamook Bay and Estuary.
Nov 1999	Flood
Dec 1999	Tillamook Bay National Estuary Project publishes Comprehensive Management Plan.
May 2000	Feasibility Study Advisory Council formed and monthly council meetings commence.
May 2000	Notice of Intent (NOI) issued for the Tillamook Bay and Estuary Flood Damage Reduction and Ecosystem Restoration Project Draft EIS.
Jul 2000	Public scoping meetings held for USACE Draft EIS preparation.
2001	Wetlands Management Plan Development Team formed.
Nov 2001	Final Wetlands Management Plan completed.
Jan 2002	Flood
2002-2003	Tillamook County purchases approximately 392 acres for wetland restoration.
Jun 2002	Tillamook Bay Habitat and Estuary Improvement District formed.
Jul 2002	USACE Feasibility Study public meetings.
Feb 2005	USACE Feasibility Study released; initial hydraulic modeling showed restoration of only the 392 acres purchased in 2002/2003 would not result in flood hazard reductions.
Dec 2005	Flood
Apr 2006	2006 Flood Summit convened.
Nov 2006	Flood
Dec 2006	Tillamook County and City of Tillamook apply for designation as an Oregon Solutions Project.
Apr 2007	The "Tillamook Basin Flooding Reduction Project" is approved as an Oregon Solutions Project.
Nov 2007	Declaration of Cooperation and Statement of Assurances signed by 24 federal, state, and local agencies, non-profit organizations, and local business interests.
Nov 2007	The Oregon Solutions Project Team, in coordination with USACE, formulates Project Exodus, a combination of the Hall Slough Project and the Modified Wetland Restoration and Swale Project.
Dec 2007	Flood
2008	Dean Dirt Pile Project removes 12,000 cubic yards of fill material that impeded floodwater discharge in the North Tillamook City floodplain.
Sep 2008	Wilson/Trask project constructed to speed drainage and shorten the inundation duration of floodwaters near Highway 101.
Dec 2008	Trask River Hook channel culvert/bypass project tabled due to high cost.
Apr 2009	Tone Road Spillway project constructed.
Aug 2009	Hydraulic Engineering Center’s River Analysis System (HEC-RAS) model results on three projects (South Bank Wilson River Berm, North Bank Wilson River, and the initial Southern Flow Corridor project) presented to the Oregon Solutions Design Committee. The combination of these projects was called Project Exodus and demonstrated the greatest flood reduction benefits and area of effect.
2009	City of Tillamook Flood Mitigation Plan updated.
Feb 2010	Final Project Exodus Report completed.

Year	Event
Jun 2010	Analysis of the SFC project alone and in combination with the North Bank and South Bank Wilson River Alternatives completed. Southern Flow Corridor Alternative determined to provide flood protection benefits on its own.
May 2011	In response to feedback from landowners impacted by potential land acquisitions, the alternative was modified to accommodate landowner requests. This Southern Flow Corridor – Landowner Preferred Alternative was unanimously approved by the Oregon Solutions Design Committee.

Source: Levesque 2013

1.1.3 Conditions Contributing to Flood Risk

Historically, several factors have tended to aggravate flooding problems in Tillamook County. Hydrologic and sediment regimes were altered in portions of the basin following extensive timber harvests in the early- and mid-1900s. Subsequently, a series of four forest fires, often referred to as the "Tillamook Burns" in 1933, 1939, 1945, and 1951 destroyed about 555 square miles of old-growth in the Nehalem, Miami, Kilchis, Wilson, and Trask River watersheds (United States Environmental Protection Agency [EPA] 1998a). These fires are generally regarded as having been crown fires that burned all of the vegetation, but many areas were probably also fires in logging slash of areas that were harvested. Some sources suggest there were more than four fires, but all agree the most significant fires occurred from the 1930s through the 1940s.

The loss of tree canopy and vegetative ground cover due to these fires resulted in altered hydrologic and sediment regimes because a greater proportion of the precipitation was delivered directly to streams and rivers over erosive slopes instead of being attenuated via interception and evapotranspiration by native vegetation and through infiltration into undisturbed soils. Most of the sediments entering stream channels in the upper basin via surface erosion and mass failures are transported downstream all the way to the delta in Tillamook Bay during high flow events (Pearson 2002).

As the river channels approach the Bay, their stream gradients and ability to transport bedload materials and suspended sediments decrease. The broad, flat floodplains of Tillamook Bay have been formed by the sediment deposits from the five major rivers that empty into the Bay. The historic condition of the delta was one of a broad, flat plain and marsh complex intersected by numerous sloughs and tidal channels.

Deposition of sediments in the lower reaches of these rivers has reduced the channels' capacity to transport floodwaters. Overbank deposits of sediment also result in some channel reaches being higher than the surrounding farmland. Tillamook Bay has become shallower due to the deposition of the annual sediment load from the rivers and from inputs of beach sands from the ocean. Ocean beach sands comprise up to 60 percent of the sediments in the western portion of the bay (McManus et al. 1998). The breaching of the Bayocean spit due to coastal erosion in 1952 had a major impact on the Bay when millions of cubic feet of sand were deposited into the Bay by storms during high tides (EPA 1998a). It was 4 years before the breach was closed by USACE in 1956 (Coulton et al. 1996). Approximately half of the total sediment currently in the Bay is attributable to marine beach sand sources (Natural Resources Conservation Service [NRCS] 2001).

Today, much of the watershed has been reforested, and the limited bathymetry available for the Bay indicates that aggradation has slowed, if not slightly reversed, in recent decades (Bernert and Sullivan 1998). However, frequent flooding and related damage within portions of the City of Tillamook are still very major concerns.

1.1.4 Conditions Contributing to Habitat Degradation

Ongoing impacts from past land conversions of saltwater delta and floodplain to farmland and urban development continue to affect estuarine-dependent species. Historically, bottomland forests and open grasslands covered the rich alluvial plain of the Tillamook Valley, which also regularly flooded in winter. The lowland floodplain's off-channel sloughs, oxbows, and wetlands provided ample habitat for rearing fish. The Tillamook basin has lost most of its floodplain and lowland wetlands. Much of the landscape has been diked, ditched, filled, drained, and cleared for agricultural uses. Most lowland riparian areas have been cleared of vegetation, except for brush and grass. Instream habitats have been channelized, straightened, riprapped, and mined for sand and gravel, or they were dredged to maintain navigation.

Some tide gates and culverts cut off fish access to remaining wetland habitat, such as the tide gates on Blind Slough. Tidal sloughs were adversely impacted by adding tide gates, filling channels, and disrupting hydrologic connectivity in the floodplain and wetlands. Water quality in sloughs in the river delta area currently exhibits low dissolved oxygen and increased turbidity. Water quality behind tide gates can suffer due to long residence times and restricted access to tidal and other water exchange.

When a floodplain has been channelized or constricted with levees, flood events can result in impacts on the remaining stream morphology and aquatic habitats. Water quality is affected by increased turbidity and contaminants in runoff from adjacent farms and urban areas that are mobilized during a flood event. While most native species inhabiting the Tillamook basin have adapted to survive flood events, individuals can be harmed if they are unable to retreat to refuges. Refuges would include upland areas for terrestrial species or low velocity side channels for aquatic species. Finally, invasive plant species can be mobilized and spread during flood events.

Oregon Coast coho are listed as threatened under the Endangered Species Act (ESA). The National Marine Fisheries Service (NMFS) is currently drafting a Recovery Plan for Oregon Coast coho, which includes a plan for Tillamook basin. The Draft Recovery plan is tentatively scheduled to be released for public comment in late 2015 (Walton 2015). Oregon Coast coho populations have been severely impacted by the loss of off-channel rearing habitat in tidal and freshwater sloughs and oxbows across the Oregon coast (Tillamook Bay National Estuary Project [TBNEP] 1998a). Almost 90 percent of the Tillamook Bay estuary tidal wetlands have been lost to agricultural and urban/residential development (Tillamook County 2013). The current coho population in the Bay is estimated to represent only about 1 percent of historic levels (Tillamook County 2013). Lack of available tidal wetland rearing habitat limits the potential for recovery of coho both within Tillamook Bay and across their entire Oregon Coast Evolutionary Significant Unit (ESU).

Loss of saltwater estuarine and tidal habitats has negatively impacted many other species that may occur in the area, including other anadromous species: Oregon coast spring and fall

Chinook, Oregon coast chum, Oregon coastal cutthroat trout, winter steelhead and Pacific lamprey. Chinook salmon are particularly dependent on tidal wetlands because they use them extensively for rearing. Bird species that have been negatively impacted by habitat changes include the threatened Marbled murrelet, California brown pelican, American peregrine falcon, olive-sided flycatcher, Bald eagle, Aleutian Canada goose, and band-tailed pigeon (NOAA 2013). Many other fish, bird, mammal, amphibian, and invertebrate species that are not currently included on federal or state lists of species of concern have also been similarly and negatively impacted by loss of this estuarine habitat. More details of the effects of historical land use on biological resources are provided in Section 4.6.

1.2 Project Study Area

The study area for this EIS, shown on **Figure 1-4**, includes portions of the City of Tillamook, Tillamook Bay, the Tillamook River, Trask River, Wilson River as well as Blind Slough, Hall Slough, Dougherty Slough, Hoquarten Slough, and Nolan Slough. The study area includes the area that would be directly affected by each alternative and any adjacent lands that may be affected by each alternative. The areas encompassed by each alternative are shown on figures in Section 3 under the description for each alternative. The area of effect for each alternative is expected to extend beyond the construction footprint because each alternative is expected to affect flooding in the Tillamook Valley and fish and wildlife habitats that may affect populations in the rivers and the bay. The Tillamook Valley is an agricultural area dominated by dairy farms. Recreational and commercial fishing and shellfish harvesting and tourism associated with the coastal bays and beaches are also significant components of the local economy.

Each resource evaluated in this EIS may have a slightly different study area because the potential for effects to be expressed in areas beyond each project area may vary. The study area for each resource is described in each subsection in Section 4. Currently the study area includes an extensive system of levees along the rivers and sloughs of the Tillamook Bay delta. The SFC project area is roughly bounded by the Wilson and Trask Rivers and Hall Slough (**Figure 1-4**). Flooding in this area is shown on **Figure 1-5**, which presents a view over the proposed project area looking west out over the Bay towards the ocean. The perimeter levees along the Trask and Wilson Rivers are visible above the floodwaters in **Figure 1-5**.

1.3 Lead and Contributing Agencies

FEMA is the lead federal agency for preparation of this EIS. Other agencies may be involved in the EIS process because they have special expertise in or knowledge of environmental issues, they have jurisdiction by law, or they must approve a portion of the Proposed Action (40 CFR 1501.6).

FEMA invited NOAA Restoration Center, USFWS, and USACE to be cooperating agencies and all have accepted. Each cooperating agency has certain statutory authorities and responsibilities under NEPA for this environmental review as described below. Both NOAA and USFWS are proposing to provide grant funding that would support portions of the project.

In addition to the lead and cooperating agencies, there are a number of other federal, state, and local agencies contributing financial and technical resources to the project as described below.

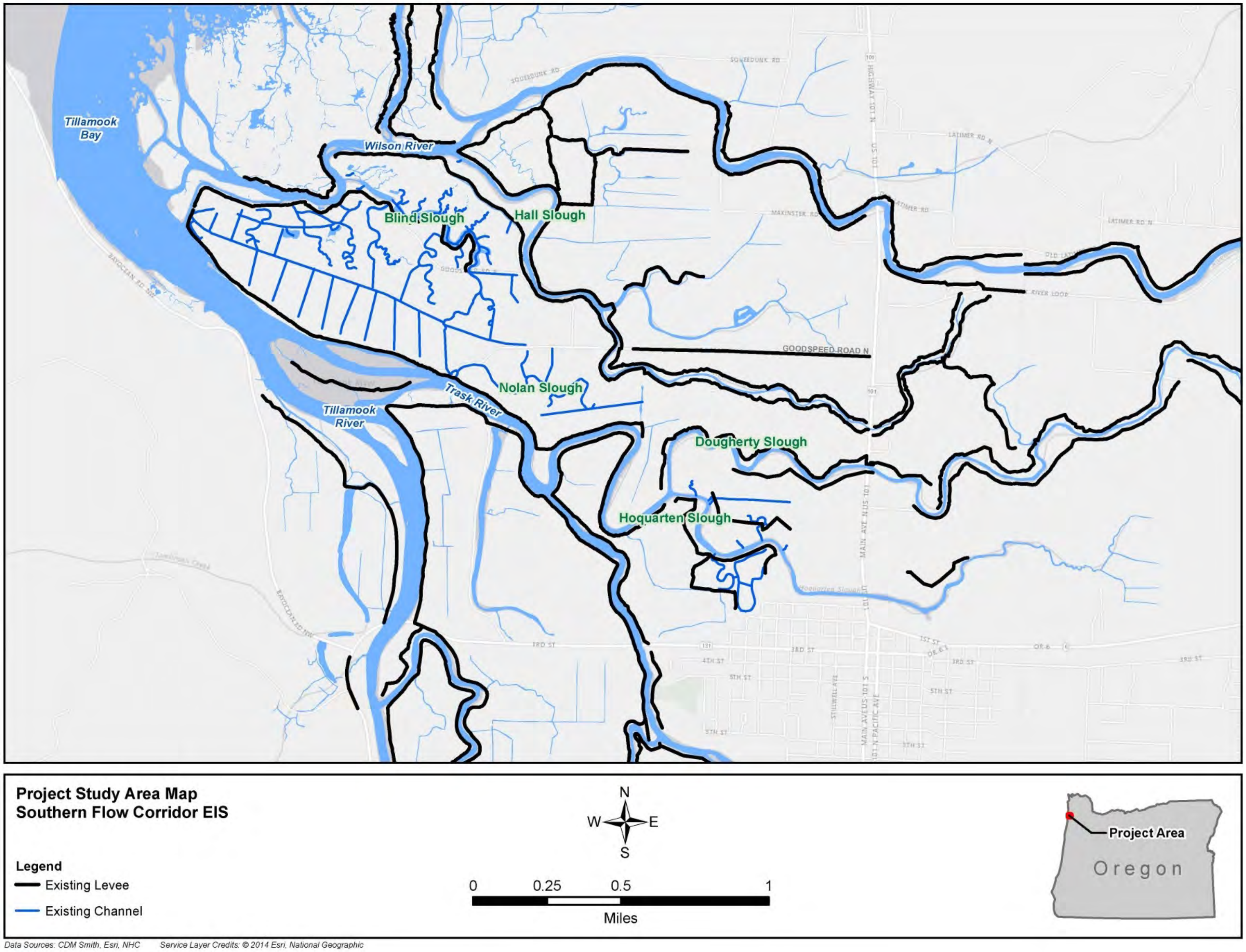


Figure 1-4. Project Study Area

Figure 1-5. Flooding Over the SFC Project Area and Tillamook Bay November 1999

1.3.1 FEMA

As lead federal agency, FEMA must evaluate potential environmental and social effects and consider those impacts during the decision-making process prior to making a grant funding decision. FEMA's funding authority is provided under the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1973 (Stafford Act), as amended, which provides a range of federal funding assistance to state and local governments to supplement efforts and resources in reducing damage or loss from major disasters and/or emergencies.

The proposed project would receive financial assistance through the FEMA PA grant program, which provides assistance to state, tribal, and local governments and certain types of private non-profit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President of the United States.

Through the PA grant program, FEMA would provide supplemental federal disaster grant assistance to POTB for an "alternate project." As previously noted, the original project was to repair the POTB rail line damaged by flooding and severe storms in December 2007. It was determined the public welfare would not be best served by restoring that facility or its function to its pre-disaster design. PA funding can be applied to "alternate" projects to repair or expand other public facilities, construct new public facilities, or fund hazard mitigation measures. Hazard mitigation projects funded with PA grant program funding are subject to cost effectiveness, technical feasibility, and regulatory and executive order compliance requirements (FEMA 2007). The alternatives considered in this EIS will be subject to these evaluation criteria as explained in Section 2.

1.3.2 NOAA Restoration Center

NOAA's Restoration Center provides support for restoration projects in the nation's coastal, marine, and migratory fish habitats to improve sustainable fishery production. Restoration Center technical staff work with public, private, and government partners on restoration project designs to ensure environmental compliance and maximize restoration project success. As a cooperating agency, NOAA has worked with FEMA and the project applicants on alternative designs and the analysis of potential environmental impacts presented in this EIS.

In addition to supporting the alternative design and environmental impact analysis, NOAA, through its Coastal and Estuarine Land Conservation Program (CELCP), has provided grant funding for property acquisitions included in the proposed project area. Contingent with this funding were special deed conditions requiring maintenance of the property "in perpetuity as open space, natural preserve, wildlife habitat, or cultural/historical landmark" (NOAA 2003a).

NOAA will use the analyses in this EIS to inform its decision-making process on continued funding support of the SFC project. In addition, NOAA is the federal lead agency for compliance with the ESA for listed species and critical habitat under their jurisdiction that may be affected by project implementation.

1.3.3 USACE

USACE Regulatory Branch regulates the placement of fill material in waters of the U.S., which include wetlands, and dredging activities and is a cooperating agency for the EIS. The proposed project will require regulatory review by USACE for work that may include construction of new levees in wetland areas, installation of new floodgate structures, dredging of new channels, and the reconnection of wetland areas to tidal influences. USACE Planning Division was directly involved in the early feasibility screening of a large range of alternatives to address flooding in the Tillamook Valley and has special expertise related to the history of the project as well as flood control measures and levee construction.

USACE will use this EIS to comply with NEPA requirements in its review of future permit applications for the proposed project.

1.3.4 USFWS

USFWS is the lead agency for the consultation on impacts to federally listed species and critical habitat under their jurisdiction under Section 7 of the Endangered Species Act. FEMA will rely on the results of that consultation in partial compliance with ESA for FEMA's Proposed Action. In addition, USFWS has special expertise with respect to threatened and endangered species and is contributing their expertise to support the analyses in this EIS. USFWS is a cooperating agency under the EIS. USFWS is proposing to provide grant funding to support the Proposed Action using National Coastal Wetlands Program funds.

USFWS' Habitat Restoration programs provide technical, financial, and planning support for restoration projects that engage willing landowners to restore and conserve habitat for the benefit of federal trust species. USFWS funds or carries out projects under the Partners for Fish and Wildlife, Fisheries, Coastal, and Recovery programs. These actions fulfill natural resource responsibilities assigned to USFWS under the Fish and Wildlife Coordination Act, Endangered Species Act, and the Partners for Fish and Wildlife Act.

1.3.5. Other Contributing Agencies

Many other state and local agencies have contributed to the development of the project and the analyses in this Draft EIS.

Oregon does not have a state level environmental review process that parallels NEPA; therefore, a state level EIS is not required. However, many state and local agencies have been involved in developing alternatives or may provide funding or permit construction. These agencies will benefit from the analyses developed in this EIS and the public reviews that are an integral part of the NEPA process. Many of these agencies have also contributed technical expertise to FEMA in the development of this EIS. State and local contributing agencies include:

- Oregon Office of Emergency Management
- Port of Tillamook Bay
- Tillamook County

- Oregon Watershed Enhancement Board
- Tillamook Estuary Partnership

1.4 Scope of this EIS

This EIS analyzes the potential effects of constructing and implementing three action alternatives and the No Action Alternative. The alternatives are described in Section 3 and include the No Action Alternative, the Southern Flow Corridor – Landowner Preferred Alternative (Proposed Action), Hall Slough Alternative, and the Southern Flow Corridor – Initial Alternative. The three action alternatives are analyzed at a project level, and the direct, indirect, and cumulative impacts are presented for each alternative.

Selection of topics to be addressed in the EIS was based on concerns raised during public scoping (see Section 1.5 and Appendix B) and on regulatory and FEMA policy requirements (see Appendix C). These issues involve resources that could be beneficially or adversely affected by the action alternatives. As described in this EIS, the action alternatives are generally expected to have some adverse construction-related, short-term and/or localized effects, but the long-term effects are expected to be beneficial for most resource areas evaluated.

Resource topics evaluated include:

- Construction Impacts
    a. Noise
    b. Traffic
- Water Resources
    a. Floodplains
    b. Wetlands
    c. Hydrology
    d. Water Quality
    e. Groundwater Resources
- Biological Resources
    a. Vegetation
    b. Fish and Wildlife
    c. Threatened and Endangered Species
- Physical Resources
    a. Geology and Soils
    b. Coastal Resources
    c. Air Quality
    d. Climate Change
    e. Hazardous Materials
    f. Visual Quality and Aesthetics
- Cultural Resources
- Socioeconomics
    a. Regional Economics

b. Environmental Justice
c. Public Health and Safety
d. Recreation

The NEPA review of the alternatives and the final decision must be conducted within the framework of numerous laws, regulations, and executive orders. Some of these authorities pertain directly to FEMA grant funding authorities. Others establish regulatory compliance standards for environmental resources or provide guidance for management of environmental resources (e.g., ESA for the protection of threatened and endangered species). Construction and implementation of the Proposed Action could have effects on cultural resources, water resources, fish and wildlife and their habitats, or on the agricultural economy of the Tillamook area. Applicable regulations that guide the evaluation for each of these resource categories are briefly described in the appropriate subsections of Section 4.

1.5 Public Involvement

1.5.1 Previous Public Involvement

Extensive public outreach and involvement has been conducted as a part of the Tillamook Valley flood protection investigations and actions described above in **Table 1-2** by all of the parties involved. Public involvement has been provided by the federal, state, and local partners involved in the USACE feasibility studies and in the Oregon Solutions Project.

In 2000, USACE began a NEPA EIS process to evaluate alternatives for flood damage reduction and ecosystem restoration in the Tillamook Valley. The USACE EIS process was never completed, but early public involvement was focused on many of the same areas and concerns as the current studies.

Prior public involvement activities also include the extensive outreach conducted as a part of the Oregon Solutions Project initiated in 2007. This outreach included the establishment of a Project Team and Design Committee of 37 governmental agencies, non-profit organizations, and local business interests that met regularly during the identification and evaluation of potential solutions to flooding in Tillamook Valley. The Tillamook Bay Habitat and Estuary Improvement District (TBHEID) played an important role in this public involvement effort with its outreach to its member residents and agricultural and commercial interests. These early public involvement efforts are described in more detail in Section 7.

1.5.2 Current Public Involvement

Public involvement is an important part of the NEPA process. The success of NEPA as an environmental disclosure and problem-solving law is based on open decision making. NEPA provides opportunities for public involvement at several steps in the environmental review process, including public scoping and public review of a draft EIS.

A public scoping process as required by 40 CFR 1501.7 was completed for the SFC project. A notice of intent (NOI) to prepare an EIS for the SFC project was published in the *Federal Register* on May 6, 2014. The NOI provided information on the project and the decision-making process (Appendix A).

The public scoping period was 30 days from May 14, 2014 to June 13, 2014. Scoping allows the public, interested parties, and government agencies to identify issues and concerns to be addressed in the EIS. FEMA conducted a public scoping meeting on May 28, 2014, in Tillamook, Oregon. The scoping meeting solicited input from the public, local businesses, associations, affected government agencies, and other interested parties about the environmental topics to be included in the EIS and the issues to be analyzed in depth. In addition, an agency scoping meeting was held on May 28, 2014, in Portland, Oregon.

A total of 38 comment submissions from members of the public or agencies were received by mail, email, comment card left at the public meeting, or fax during the scoping period. The issues and concerns identified are summarized in **Table 1-3**. A more detailed description is provided in the Scoping Report in Appendix B. These issues and concerns provided the basis for selection of the topics addressed in detail in Section 4, the Affected Environment and Environmental Consequences section of this EIS. Scoping comments regarding alternatives to the Proposed Action are addressed in Section 3.7.

Section 7 provides a detailed description of the EIS public outreach and involvement process and its results.

Table 1-3. Summary of Concerns Raised During Scoping[1]

Purpose and Need	Support (11) Do Not Support (0)		
Proposed Alternatives	No Action (1) Support (1) Do Not Support (0) Hall Slough (5) Support (4) Do Not Support (1)	SFC – Landowner Preferred (10) Support (5) Do Not Support (5) Modified Wetland Acquisition with Swale (1) Support (1) Do Not Support (0)	SFC – Initial (0) Support (0) Do Not Support (0) Other Alternative Suggestions (8)
Potential Impacts	Biological Resources (47)[2] Vegetation (17) Fish and Wildlife (27) Threatened and Endangered Species (9) Water Resources (98) Floodplains/Flood Protection (58) Wetlands (5) Surface Water (32) Groundwater (4) Construction Impacts (0) Noise (0) Traffic (0) Hazardous Materials (0)	Physical Resources (31) Geology and Soils (19) Coastal Resources (12) Air Quality (0) Climate Change (2) Visual Quality and Aesthetics (1) Cultural Resources (1) Socioeconomics (56) Regional Economics (40) Environmental Justice (0) Public Health and Safety (11) Public Services and Utilities (5)	

[1] *Tallies represent best judgment for interpretation of supportiveness and assignment among topics. See Appendices E and F in the Scoping Report in Appendix B for full text of each comment.*
[2] *Subtotals do not equal the total because Fish and Wildlife overlaps with Threatened and Endangered Species.*

1.5.3 Future Public Involvement

The Draft EIS is made available for review by the public, tribes, and agencies. There will be a public workshop held during the public comment period on the Draft EIS. This workshop will provide an opportunity for interested parties to provide comments on the Draft EIS. Comments will also be accepted in writing throughout the public comment period. The comments received during this review and comment period will be considered, and appropriate changes will be made to the document in the preparation of the Final EIS.

Once the Final EIS is reviewed and approved by FEMA, it will be distributed to agencies, non-governmental entities, individuals, and organizations for review. A final decision on the Proposed Action would not be made until at least 30 days after the Final EIS is made available for review. The final decision is documented in a record of decision (ROD). The ROD is published in the *Federal Register,* indicating that FEMA is making a decision on the Proposed Action. The ROD is a written public record explaining why the lead agency, in this case FEMA, is making the decision that is described in the ROD. The ROD will include:

- An explanation of the decision on the Proposed Action
- Factors involved in making the decision
- Alternatives considered and the environmentally preferred alternative
- Adopted mitigation measures, if necessary, and monitoring and enforcement measures

Each cooperating agency, including NOAA, USFWS, and USACE, would independently review and approve the Final EIS and issue its own decision document addressing the decision each agency would need to make with respect to the Proposed Action.

SECTION 2 Purpose and Need

2.1 Project Purpose

The purpose of the Tillamook Bay SFC project is to reduce life safety risk from floods and reduce flood damages to property and other economic losses from floods while also contributing to the recovery of federally listed Oregon Coast coho and restoring habitat for other native fish and wildlife species.

The project would also need to be consistent with the purposes of the funding agencies' programs. The purpose of FEMA's PA grant program is to provide assistance to state, tribal, and local governments and certain types of private nonprofit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President. The purpose of NOAA's Restoration Center is to support the restoration of fishery and coastal habitats by providing federal financial and technical assistance to encourage locally led coastal and marine habitat restoration and promote stewardship and conservation values for NOAA trust resources. The purpose of USFWS' habitat restoration programs is to restore and conserve habitat for the benefit of federal trust species.

2.2 Project Objectives

The objectives for this action are to reduce flood damage in the lower Wilson River floodplain, including portions of Tillamook, Oregon, near the Highway 101 business corridor, and to re-establish a properly functioning and self-sustaining estuarine tidal marsh ecosystem that will provide critical rearing habitat for salmonids and other native fish and wildlife species in the Tillamook Bay estuary.

The objectives for this action are:

- Reduced flooding in the Highway 101 business corridor in Tillamook, Oregon during 100-year and lesser flood recurrence events.
- Reductions in life safety risk from floods that may result from road closures that impede emergency response vehicles' access for medical and other emergencies.
- Reductions in damages to buildings, including residential, commercial, agricultural, and public buildings; other infrastructure (roads, bridges, and utilities); and agricultural land by reductions in the depth, frequency of occurrence, and spatial extent of flood events across the lower Wilson River floodplain and in the Highway 101 business corridor in Tillamook, Oregon.
- Reductions in economic losses from floods, including the economic impacts of road closures and other costs incurred when buildings are damaged such as displacement costs for temporary quarters while damaged buildings are repaired.
- Improved freshwater and estuarine water quality, including reductions in water temperature during summer baseflow with corresponding increases in dissolved oxygen and reductions in turbidity (suspended sediments).

- Increased habitat quality, quantity, and complexity across a range of tidal wetland and instream habitats that will provide critical rearing habitat for salmonids and other native fish and wildlife species in the Tillamook Bay estuary.

Properties currently in County ownership in the proposed project area were obtained for the purpose of tidal wetland restoration. Potential future land acquisitions are identified for each alternative because they appear to meet the objectives of the project or an alternative under consideration. However, acquisition of these properties or any other properties outside of the existing County ownership would be reliant upon the willingness of the individual owner to sell or otherwise relinquish property rights to the County or POTB to further the objectives of the proposed project.

While not specifically a project objective, alternatives should not generate hazards to properties outside of public ownership or public lease. For example, properties not directly included in the project area should not experience tidal or flood flows beyond the existing condition, and flood mitigation measures, such as the establishment of setback revetments, may be required to ensure existing flood hazard conditions are not degraded on these adjacent lands.

2.3 Need for the Project

The need for the project results from the area's history of severe repetitive flooding with widespread damage to property, road closures, and other economic losses. In addition, several fish and wildlife species that historically depended on the wetland, tidal marsh, and aquatic habitats of the estuary, such as Coastal coho and Marbled murrelet, have been federally listed as threatened or endangered.

Future unmitigated flooding in the Tillamook Valley will continue to contribute to potential future life safety risks and physical and economic damages to property and businesses in the floodplains as described in Section 1.1. Continued degradation of important fish and wildlife habitats in the estuary through blockages to fish passage, historic losses of aquatic and wetland habitats, and altered sediment erosion and deposition regimes (as described in Section 1.1.2) may lead to listing of additional species under the Endangered Species Act and hamper recovery plans for currently listed species that use the project area.

Of those who commented on the purpose of and need for the project during the public scoping process, all supported the stated purpose to reduce flood damage and restore habitat.

2.4 Criteria for Alternatives to Meet the Purpose and Need

Consideration of alternatives under NEPA is not limited to alternatives that meet the funding agency's criteria for funding. However, the grant eligibility criteria for FEMA's PA program, NOAA's CELCP funds, and USFWS' National Coastal Wetlands Program funds provide useful guidelines to consider when evaluating whether an alternative meets the purpose and need for the project. The following criteria were used in evaluating alternatives against the purpose and need.

2.4.1 Hazard Mitigation

FEMA Public Assistance Policy 9525.13 on Alternate Projects provides guidance on allowable uses and limitations of alternate project funds when restoration of the original damaged facility is not in the best interest of the public. Mitigation projects are eligible for funding under the alternate project policy and may include the same type of projects as would be eligible for funding under Section 404 of the Stafford Act (the Hazard Mitigation Grant Program [HMGP]).

While the HMGP criteria do not need to be strictly applied to alternate projects, they do provide useful guidelines for screening of alternatives that are applied to the consideration of alternatives for this project.

To meet the purpose and need, alternatives should:

1. Be technically feasible and implementable.
2. Solve a problem independently, consistent with 44 CFR 206.434(c)(4).
3. Be cost effective and able to substantially reduce the risk of future damage, hardship, loss, or suffering resulting from a major disaster, consistent with 44 CFR 206.434(c)(5) and related guidance.
4. Provide for long-term effectiveness and benefits (between 5 and 10 years, depending on the type of action).
5. Be consistent with the goals and objectives identified in the current FEMA-approved state mitigation plan and local mitigation plan for the jurisdiction in which the action would occur.
6. Conform to 44 CFR parts 9 and 10 and with all applicable environmental and historic preservation laws, implementing regulations, and executive orders, including the National Environmental Policy Act (42 United States Code [U.S.C.] 4321-4347), National Historic Preservation Act of 1966 (54 U.S.C. 300101 et seq.), Endangered Species Act (16 U.S.C. 1531-1544), Executive Order 11988 (Floodplain Management), Executive Order 11990 (Protection of Wetlands), and Executive Order 12898 (Environmental Justice).
7. Be located in a community that is participating in the National Flood Insurance Program (NFIP) and is not on probation, suspended, or withdrawn from the NFIP if the community has been identified as having a Special Flood Hazard Area (SFHA) through the NFIP (i.e., a Flood Hazard Base Map or Flood Insurance Rate Map has been issued to the entity).

2.4.2 Habitat Restoration

To be eligible for NOAA Restoration Center funding under the Community-based Restoration Program, a project should be consistent with the program’s priorities (NOAA 2008). To meet the purpose and need, alternatives should:

- Provide benefits to specific NOAA trust resource species and habitats, which include but are not limited to estuaries, salt marshes, and riparian habitat near rivers, streams, and creeks used by diadromous fish
- Focus on restoration of habitats whose regional condition is compromised due to loss, fragmentation, presence of invasive species, or loss of functionality

- Benefit social and economic values (e.g., benefits to essential fish habitat that support commercial or recreational fishery resources or improvements in aesthetic and stewardship value of NOAA trust resource habitats) within the region if possible
- Incorporate proven effective restoration techniques
- Address causes of habitat degradation and loss
- Maximize cost-effectiveness

USFWS National Coastal Wetlands Program grant criteria are similar, requiring that eligible projects:

- Reverse coastal wetland loss or habitat degradation
- Ensure at least 20 years of conservation benefits for coastal wetland functions
- Help accomplish the natural resource goals and objectives of one or more formal, ongoing coastal watershed management plan or effort
- Benefit any federally listed endangered or threatened species, species proposed for federal listing, recently delisted species or designated or proposed critical habitat in coastal wetlands, or state-listed species
- Provide, restore, or enhance important fisheries habitat
- Provide, restore, or enhance important habitat for coastal-dependent or migratory birds
- Prevent or reduce inputs of contaminants to coastal wetlands and associated coastal waters that are already contaminated
- Leverage other ongoing coastal wetlands conservation efforts in an area
- Receive financial support, including in-kind match, from private, local, or other federal interests
- Increase environmental awareness and develop support for coastal wetlands conservation or provide recreational opportunities consistent with the conservation goals of the site
- Address climate change concerns

SECTION 3 Alternatives

3.1 Introduction

The National Environmental Policy Act requires FEMA to consider a reasonable range of alternatives in the EIS (40 CFR 1502.14). Those alternatives must be rigorously explored and objectively evaluated. The EIS must also include an evaluation of the No Action Alternative, which serves as a basis for comparison for the evaluation of the action alternatives. The No Action Alternative is described in Section 3.3.

Identifying and analyzing alternatives is an essential part of the NEPA decision-making process. The Tillamook community has previously developed and screened many potential alternatives to address flooding in the Tillamook Valley. These community efforts are described in "*A History of the Oregon Solutions Southern Flow Corridor Project – Landowner Preferred Alternative: A Review of the Alternatives and a Summary of Public Involvement*" (Levesque 2013). This Draft EIS builds on that work, and several of these previously developed alternatives were selected to represent a range of preliminary alternatives for consideration during the scoping process.

This section includes a description of the criteria used to select a reasonable range of alternatives and a description of the alternatives carried forward into the resource-specific impact analyses of this EIS (Chapter 4 Affected Environment and Environmental Consequences and Chapter 5 Cumulative Impacts). This chapter also includes a description of the alternatives eliminated from further analysis and a brief discussion of the reasons for eliminating them.

The key features of the alternatives described in detail in Sections 3.3 through 3.6 are summarized in **Table 3-1.**

Table 3-1. Comparison of Alternatives Key Features

Alternative Feature [1]	No Action Alternative	Proposed Action: SFC – Landowner Preferred Alternative	Hall Slough Alternative	SFC – Initial Alternative
Channel construction (miles)	0.0	0.7	0.4	0.2
Channel modification (miles)	0.0	0.0	1.9	0.0
Natural channel restoration[2] (miles)	0.0	14		14 (+) [7]
Wetland restoration[3] (acres)	0.0	522	90 (-) [8]	568
Levee/road removal[4] (miles)	0.0	6.9	0.0	8.8
Levee modification[5] (miles)	0.0	2.8	6.3	0.7
New levee[6] (miles)	0.0	1.4	0.7	1.6
Flowage easement (acres)	0.0	84.7	0.0	0.0
Drainage ditches filled (miles)	0.0	3.3	0	3.3

[1] – *Measurements provided in this EIS are based on independent geographic information system (GIS) measurements and may vary slightly from values reported in previous project-related documents.*

[2] – Natural channel restoration is the length of historic side channel habitat expected to reform with the reintroduction of tidal hydrology.
[3] – Wetland restoration area includes all areas where natural tidal hydrology would be restored.
[4] – Levee/road removal includes the removal of areas of dredge spoils that impede tidal hydrology.
[5] – Levee modification includes areas where existing levees would be strengthened and/or raised and where existing levees would be lowered.
[6] – New levees would include new setback levees or levees constructed in locations where there currently are no levees.
[7] – Under Alternative 3, the length of restored channel would be expected to be greater than 14 miles because levees would be removed from around an additional 86 acres as compared to the Proposed Action.; however, relict channels are not as visible in this area on aerial photography so it is more difficult to estimate how much new channel restoration would occur.
[8] – Under Alternative 2, the area between the new setback levees would be approximately 90 acres; however, not all of this area may become wetlands under the alternative.

3.2 Alternative Development

As noted in Chapter 1, the formulation of flood risk reduction and ecosystem restoration alternatives and options in the Tillamook Valley has been underway since Tillamook Bay entered the National Estuary Program in 1994. The National Estuary Program is a network of voluntary community-based programs that safeguards the health of important coastal ecosystems across the country. The ongoing investigation and evaluation of potential flood risk reduction and ecosystem restoration alternatives and options has progressed through the USACE Feasibility Study's identification of 59 potential alternative measures that were eventually narrowed to a preferred alternative by USACE and the Tillamook community.

The USACE Feasibility Study evaluated alternatives that were not retained for further consideration based on a comprehensive evaluation (USACE 2005). For example, dredging of the river mouths was evaluated to determine if sedimentation was causing flooding problems upstream and whether dredging would alleviate problems. As described further in Section 3.7.3, dredging to increase the depth of the rivers would have a less significant reduction on flood levels than increasing the width of the channels. In addition, dredging would not provide ecosystem benefits because it would not reconnect sloughs or off-channel habitats with the rivers and the bay. Dredging was also determined to be less cost-effective and require long-term maintenance.

Through the USACE feasibility study process, the Modified Wetland Acquisition with Swale Alternative (see Section 3.7.2) was identified as a preferred alternative. Due to a lack of funds for completing the NEPA evaluation of impacts, the ESA Section 7 consultation with NMFS, and the actual project, the Feasibility Study's preferred alternative was not implemented.

In response to a major flood event in late 2005, as well as the lack of progress on implementation of alternatives identified in the USACE Feasibility Study, local and state representatives convened a Flood Summit in 2006. That group identified participation in the Oregon Solutions Program as a potential mechanism for the identification and implementation of a flood risk reduction and ecosystem restoration project.

The Tillamook Bay Oregon Solutions Project was initiated in April 2007 with 24 participating state and federal agencies, along with non-profit organizations and local business interests. In 2007, the Oregon Solutions Project Team identified three priority projects drawn from the USACE Feasibility Study projects. These priorities included the Dougherty Slough Permanent Structure, the Hall Slough Project, and the Modified Wetland Acquisition with Swale

Alternative. These three projects along with a reconnection of Blind Slough then evolved into a single alternative, which was named Project Exodus.

Analysis of different project configurations by the Oregon Solutions Design Team determined that, of the options under consideration, the creation of a flow corridor downstream of Highway 101 between Hoquarten and Dougherty sloughs and running westward toward Tillamook River and Tillamook Bay created the largest potential flood reduction benefit. This "Southern Flow Corridor" was incorporated into multiple configurations that were considered in the Project Exodus Final Report alongside actions on the north and south banks of the Wilson River (NHC 2010). The Final Report identified Project Exodus Alternative 4 as the preferred SFC configuration.

Following completion of the report, further design of a SFC project commenced. Due to limited funding opportunities and relatively smaller areas of flood reduction, the Wilson River North and South bank actions were removed from further design. In response to concerns about the potential conversion of farmland, multiple potential configurations of levee removal and setback and conveyance easements were considered in coordination with affected landowners. From this process, the Southern Flow Corridor – Landowner Preferred Alternative was formulated that maintained flood control benefits while reducing the potential conversion of farmland.

From this lengthy alternatives formulation process, FEMA identified five preliminary alternatives that were presented during the scoping process:

1. No Action Alternative
2. Proposed Action: Southern Flow Corridor – Landowner Preferred Alternative
3. Hall Slough Alternative
4. Southern Flow Corridor – Initial Alternative
5. Modified Wetland Acquisition with Swale Alternative

NEPA requires federal agencies to rigorously explore and objectively evaluate all reasonable alternatives and briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). The preliminary alternatives were assessed against the criteria for meeting the identified purpose and need and against the comments received during scoping. Alternatives considered but screened from further consideration and the justification for their dismissal are presented in Section 3.7.

Public comments received during the scoping period in response to the Proposed Action suggested alternative methods for achieving the purpose and need. These alternative methods included:

- Recommendation to dredge the rivers, sloughs, and Tillamook Bay to remove excessive sediment, which interferes with habitat function and economic activities. Many comments reiterated this recommendation.
- Recommendation to expand the project area to the northwest to include the north bank of the Wilson River.

- Recommendation to consider moving the levee proposed at the west side of the Beeler property to the west (Beeler and Aufdermauer properties are shown on **Figure 3-5**). Concerns were raised that the storage behind the levee is inadequate for agricultural drainage and flood storage.
- Recommendations that the project should address flooding in the lower Trask River as well as the proposed project area.
- Recommendation to include the Hall Slough Alternative elements with the SFC – Landowner Preferred Alternative.
- Recommendation to lower the levees from approximately 15 feet to 11 feet.
- Recommendation to protect and maintain the former Wilson Farm in agricultural uses (area is now part of the County-owned lands within the SFC study area and is shown on **Figure 3-5**).
- Recommendation to incorporate the Shilo levee upgrade.
- Recommendation to remove the levees along Hall Slough and remove spillway and some levees on the lower end.
- Recommendation that FEMA continually elevate the levees to protect farmland from rising flood elevations and install pumps to keep water levels from rising.
- Recommendation to impound water during the rainy season, which could reduce flooding. The commenter suggested the impounded water could be used for irrigation, recreation, fire control, and power generation and to fill streams during low-water flows.
- Recommendation to minimize levee changes by adjusting heights and longitudinal changes rather than removal and rebuilding of new levees.

Several of these recommendations were previously considered in the USACE Feasibility Study and were found to provide only localized flood reduction benefits or to not be feasible. Some of the recommendations are already described as components of the alternatives considered in the EIS (e.g., lowering some levees or reconnecting Blind Slough to the Bay). Several suggestions would not meet the purpose and need for addressing both flooding and habitat restoration. Finally, some of these recommendations have been considered and eliminated from further consideration as described in Section 3.7 (e.g., dredging the sloughs and rivers or preserving the Wilson farm in agricultural uses).

3.3 No Action Alternative

Under this alternative, FEMA and NOAA would not fund any of the proposed flood damage reduction and ecosystem restoration actions, and the project actions would not be implemented. Because the proposed federal funding is a significant portion of the funding needed to implement the SFC project, the No Action Alternative is defined as an alternative where there would be no further work in the project area. The No Action Alternative would not change the existing levee and wetland conditions present in the study area.

Under the No Action Alternative:

- There would be no construction in the project area.
- Existing levee configurations would remain the same.
- There would be no change in existing flood elevations in the floodplain.
- Blind Slough would not be reconnected.
- Off channel habitat and tidal wetland conditions would remain the same as the existing condition.

For the purposes of the analysis in this EIS, it is assumed that if the federal grant funding is not approved, then other potential sources of funding would also not be approved because individually they would not be sufficient to implement the project. Under the No Action Alternative, the County would retain ownership of the 392 acres previously purchased (**Figure 3-1**). The terms of the grant funding under which the County purchased the property prohibit continued agricultural uses. Therefore, it is reasonable to assume that although the levees would not be reconfigured, agricultural operations (grazing and hay production) would be phased out on the 392 acres in County ownership over time. The County would continue to maintain the existing floodgates and levees for a time because they serve to protect houses and farmland adjacent to the County-owned property. However, over time, even this activity may be phased out, allowing the levees, tide gates, and flood control structures to deteriorate. It is further assumed active wetland restoration on County lands currently in wetland uses would remain unfunded and unconnected to tidal influences.

Under the No Action Alternative, the County would complete a full characterization of the contamination, an alternatives analysis of cleanup options, a negotiated Prospective Purchaser Agreement between the County and the Oregon Department of Environmental Quality (ODEQ), which would describe the County's obligation for cleanup if the Sadri property were to be acquired, and design of the cleanup activities (Sadri property is shown on **Figure 3-5**). However, acquisition and cleanup is not proposed under the No Action Alternative.

Under the No Action Alternative, existing expenditures for maintenance would continue for some period of time. It might be reasonable to assume that under the No Action Alternative maintenance might continue for another 10 years, and it could take several decades before the levees and tide gates completely ceased to function in any capacity.

Currently, maintenance costs within the SFC area are shared between the County, TBHEID, Soil and Water Conservation District (SWCD), and the Oregon Department of Fish and Wildlife (ODFW). The County and TBHEID share levee maintenance costs on the portion surrounding the County-owned lands, and TBHEID assists its members with levee maintenance on the remaining SFC area. The SWCD is responsible for management of noxious weeds and assists with agricultural drainage issues while ODFW maintains the public parking, access, and signage within the area. Average annual maintenance costs over the past 6 years are $7,038 combined for all entities.

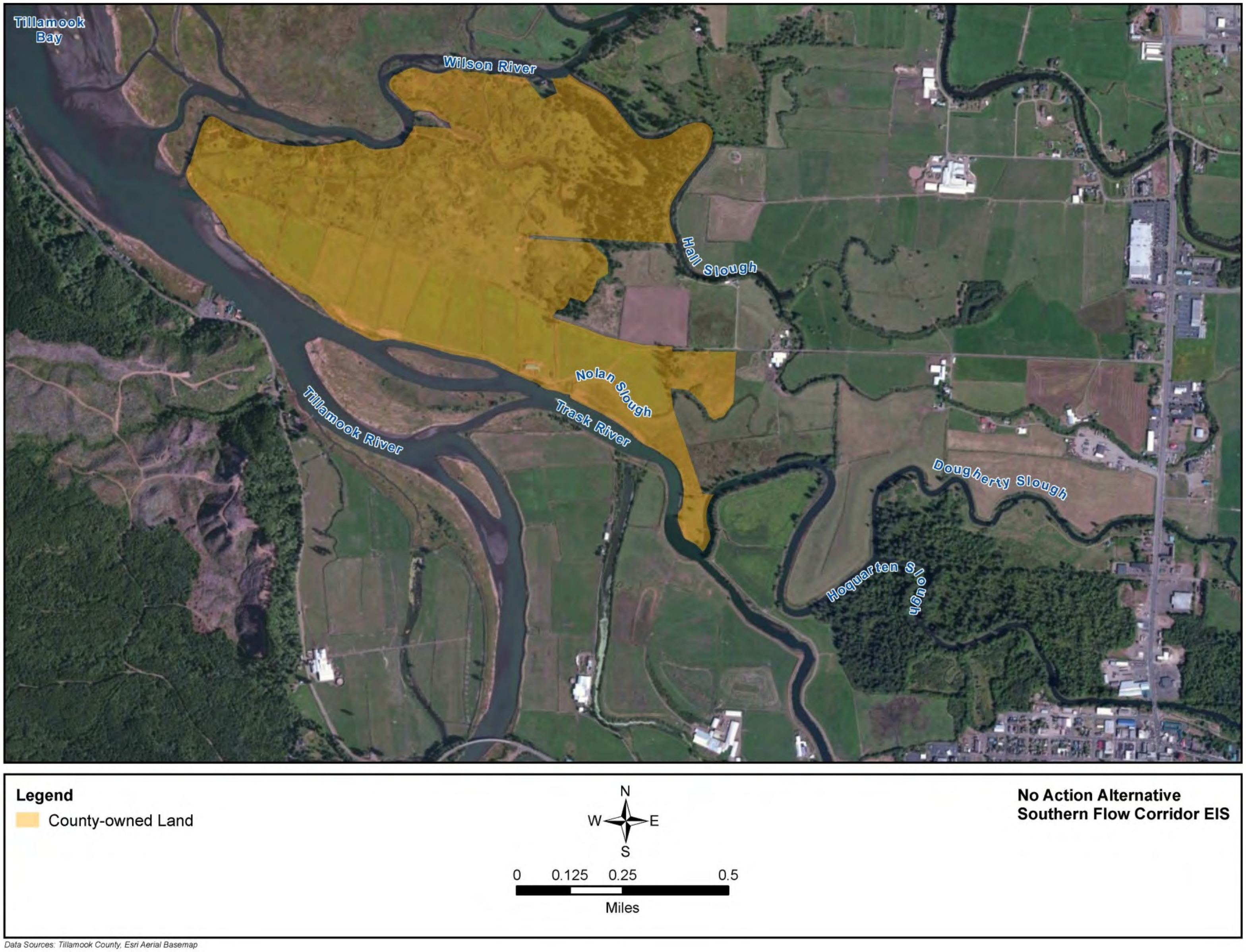


Figure 3-1. No Action Alternative

3.4 Alternative 1: Proposed Action (Southern Flow Corridor – Landowner Preferred Alternative)

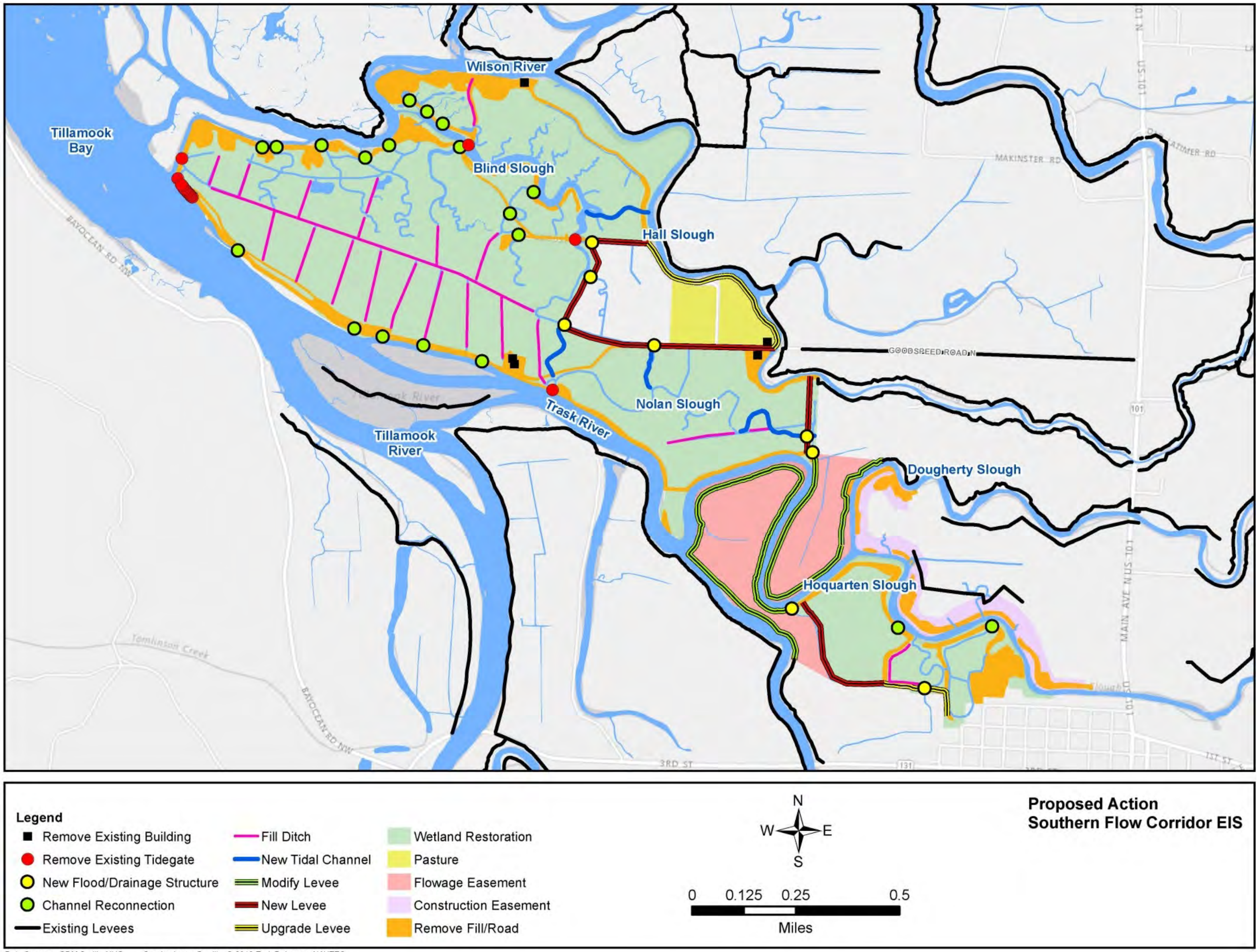
The primary intent of the Southern Flow Corridor – Landowner Preferred Alternative (**Figure 3-2**) is to remove manmade impediments to flood flows to the maximum extent possible in the lower Wilson and Trask rivers floodplain for both flood hazard mitigation and for habitat restoration. The project would accomplish this by removing existing levees and fills along the edges of the sloughs and rivers that border the project area. New setback levees would be required to protect adjacent private lands. Areas outside the setback levees would be restored to tidal wetlands.

The Tillamook Bay National Estuary Project Comprehensive Conservation Management Plan (CCMP) identified reconnecting intertidal wetlands and enhancing tidal marsh to be the most important potential action to improve habitat quality and benefit the overall ecological function of the bay. Tidal wetland restoration was identified as a key component in improving conditions for important fish aquatic and terrestrial species. The CCMP identified an objective to acquire and restore 750 acres of inter-tidal wetland habitat in the Tillamook Bay estuary.

Following completion of the CCMP, Tillamook County acquired 392 acres of wetland habitat at the tidal interface of the Wilson and Trask rivers. Analyses found this area was critical in terms of flooding in the Tillamook area (Levesque 2013). The area is cut-off from the rivers and bay by levees that surround the property. Under the Proposed Action, this area would be reconnected hydraulically to the rivers and the bay through levee removal and levee setback. Environmental restoration benefits are expected to include fish and wildlife habitat, fish passage, tidal wetland, ecosystem function, floodplain function, and water quality.

3.4.1 Alternative 1 (Proposed Action) Features

As detailed in **Table 3-2**, 6.9 miles of levees would be removed and 2.8 miles would be modified to allow floodwaters to flow across the project area and wetlands restored in the areas re-opened to tidal influences. New setback levees would be built in a new configuration to protect agricultural lands in the lower delta. A flowage easement would be required over approximately 86 acres to allow high flows to pass out to the Bay. Flood reduction benefits vary widely depending on what part of the floodplain is considered and the severity of the flood event. Preliminary design results indicate that in the vicinity of Highway 101, flood elevations could be reduced by as much as 1.5 feet north of Hall Slough and up to 0.75 feet between Hall Slough and Hoquarten Slough during a 100-year flood. These predicted reductions are based on hydraulic modeling (see Appendix E), and there is a margin of error on the predictions that may be as much as 1 foot. It is important to note the modeling approach had the modest goal of being able to simulate the *relative* benefits of alternative flood reduction actions but not necessarily predict the precise absolute values of peak water levels at all locations.



Data Sources: CDM Smith, NHC Service Layer Credits: © 2013 Esri, DeLorme, NAVTEQ

Figure 3-2. Alternative 1: Proposed Action

Table 3-2. Southern Flow Corridor – Landowner Preferred Alternative

Alternative Feature	Change From Existing Condition[1]
Channel construction	0.7 miles
Natural channel restoration[2]	14 miles
Wetland restoration[3]	522 acres
Levee/road removal[4]	6.9 miles
Levee modification[5]	2.8 miles
New levee[6]	1.4 miles
Flowage easement	84.7 acres
Drainage ditches filled	3.3 miles

[1] – Measurements provided in this EIS are based on independent GIS measurements and may vary slightly from values reported in previous project-related documents.

[2] – Natural channel restoration is the length of historic side channel habitat expected to reform with the reintroduction of tidal hydrology.

[3] – Wetland restoration area includes all areas where natural tidal hydrology would be restored.

[4] – Levee/road removal includes the removal of areas of dredge spoils that impede tidal hydrology.

[5] – Levee modification includes areas where existing levees would be strengthened and/or raised and where existing levees would be lowered.

[6] – New levees would include new setback levees or levees constructed in locations where there currently are no levees.

Figure 3-3 and **Figure 3-4** illustrate how the Proposed Action would function. **Figure 3-3** shows that removing the levee on the western end of the SFC area would only reduce flood elevations within that area. However, under the Proposed Action, fill and levees surrounding the SFC area also would be removed (**Figure 3-4**). By removing these levees, flow would be diverted from surrounding areas into the central flow corridor, allowing for broader effects. Flood benefits would include reduction in flood depths and reduction in flood duration. The extent of the effects would depend on location within the valley and the severity of the flood. These potential effects are described in Section 4.5.3 and Appendix E.

3.4.1.1 Property Acquisition

Under the Proposed Action, additional property would need to be purchased. Approximately 8.6 acres would be purchased from three property owners to consolidate the County's holdings at the western end of the project area. An additional 66 acres would be acquired with the purchase of the Sadri property and about 72 acres with the purchase of the Jones property (shown on **Figure 3-5**). These acquisitions would increase County and POTB holdings by an additional 146.3 acres. Of the lands in public ownership, about 21.3 acres would be leased back for agricultural uses (the northern Jones parcels), and the remainder would be restored to natural habitat functions. An additional 5.6 acres of City property in the southeastern corner of the project area would be included in the habitat restoration activities. A flowage easement over approximately 86 acres on the Aufdermauer and Beeler properties would be acquired, and another 35-acre construction easement would be acquired along Dougherty and Hoquarten sloughs (**Figure 3-2**).

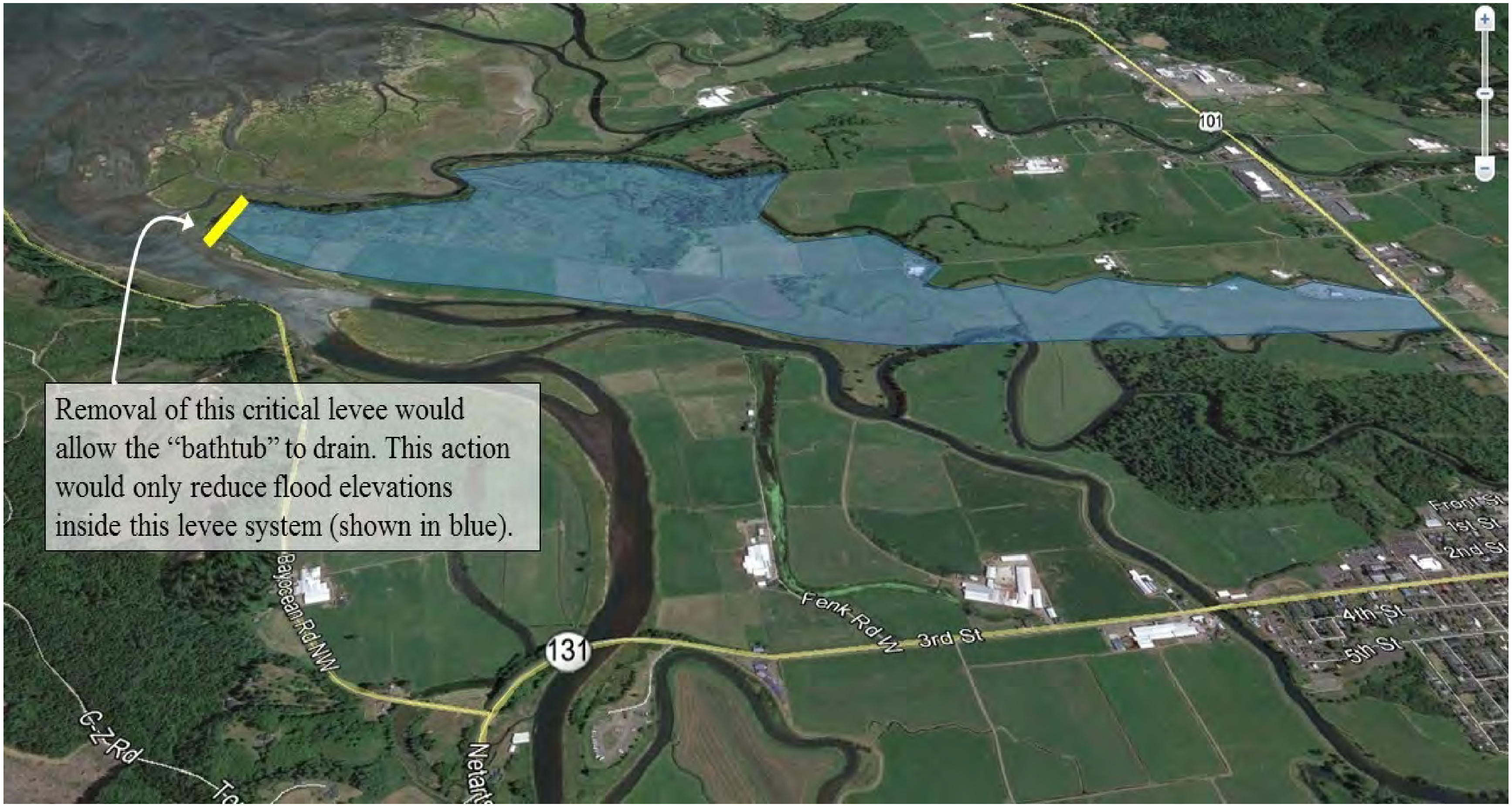


Figure 3-3: Effect of Removing Western Levee

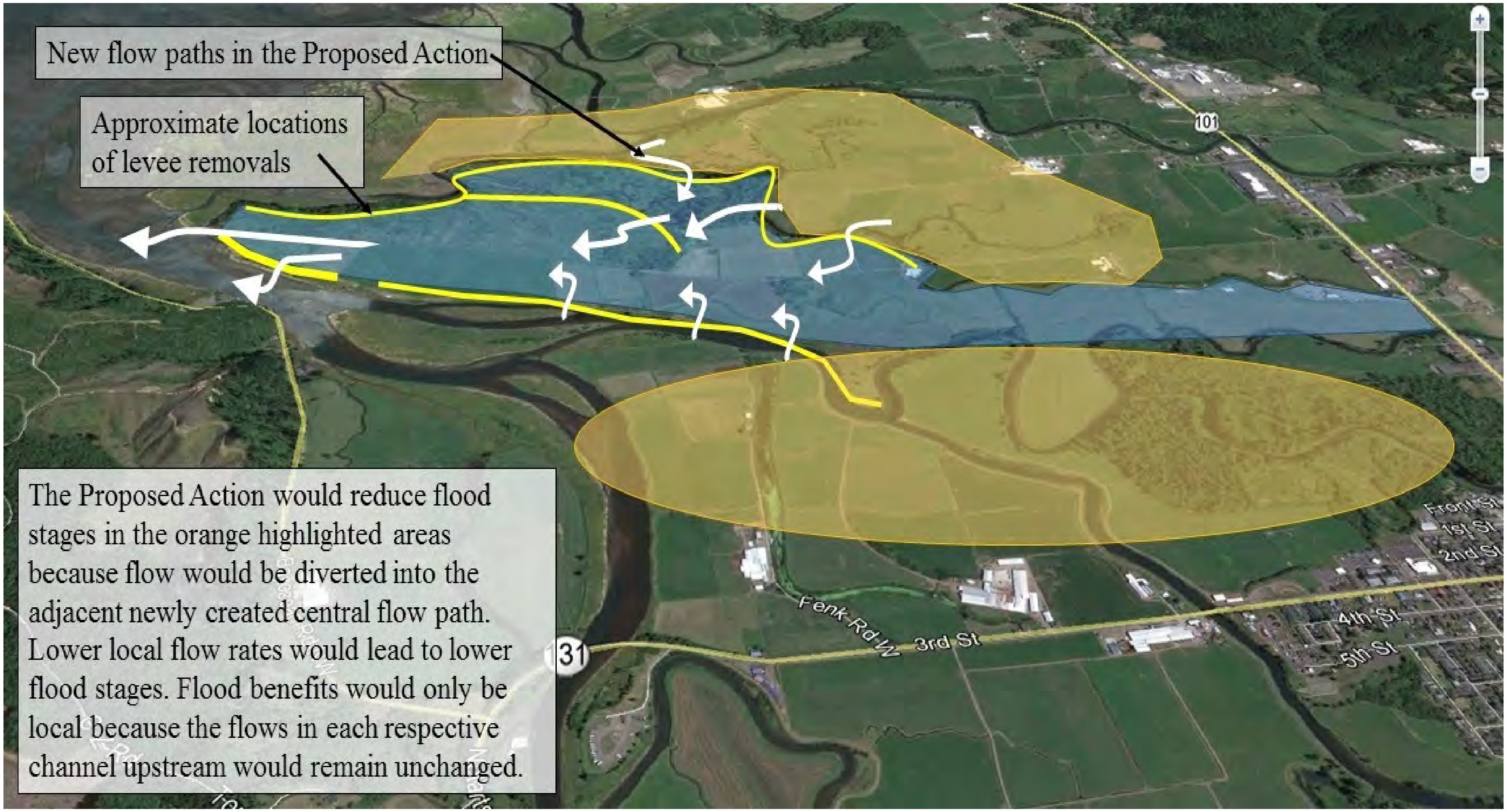


Figure 3-4: Effect of Proposed Action

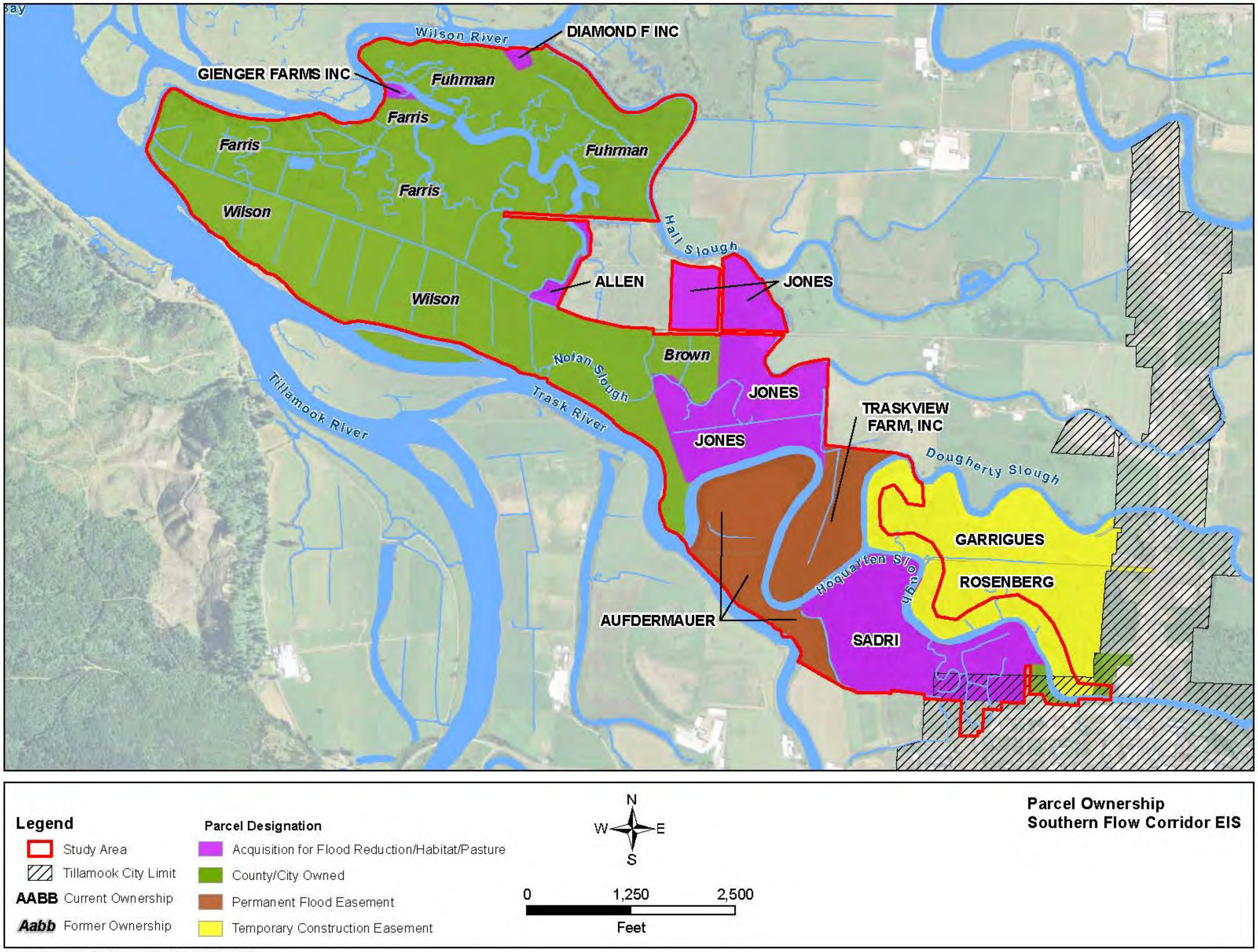


Figure 3-5. Current and Former Property Ownership within the Proposed Action Study Area

3.4.1.2 Levee and Fill Removal

Removal of the numerous levees and fills within and around the edges of the project area would increase the conveyance capacity that provides a reduction of flood elevations over a wide area of the lower Wilson and Trask rivers floodplain. Levee, road, and fill removal is shown in orange on **Figure 3-2**. In general, material would be removed to slightly below natural floodplain/marsh level. The elevation that would support marsh habitat is determined by comparison with nearby areas along the Tillamook Bay shoreline that do not have existing levees.

In the area south of Hoquarten Slough, some short levee segments parallel to the flood flow path may be left unchanged. These segments would not affect potential flood level reduction as they are parallel to the flow, and they have established trees growing on them that provide habitat benefits. The removed fill would be used for new levees and for filling drainage ditches. Any remaining fill material would be spread on site in subsided areas to speed restoration to natural salt marsh elevations or offered to adjoining farm operations to be spread over existing pastures. Low areas would be identified through a current land survey.

Vegetation would be removed in areas where levees would be removed, modified, or constructed. As much as possible, spruce trees would be left in place. Approximately 100 to 150 spruce trees and all the red alder trees along Hoquarten Slough in the southeastern portion of the study area would be removed. Several hundred more spruce would be removed along Hall Slough as a result of the berm removal along Hall Slough in the northwestern portion of the study area. Some trees would be reserved for use in offsite restoration projects; approximately 40 trees would be used by ODFW at a proposed restoration site along Beaver Creek in 2016 (Levesque 2015). Additional trees suitable for reuse in other restoration projects may be stockpiled for up to 2 years for reuse as habitat structures in other restoration projects.

3.4.1.3 New Levees and Levee Modification

New levees would be constructed to protect agricultural lands from storm surges and high tides. These proposed new levees are shown in red on **Figure 3-2**. Three areas of new levees would be constructed, including a “north levee” along the alignment of Goodspeed Road and north to Hall Slough, a “middle levee” that runs north-south between Hall Slough and Dougherty Slough near the upstream end of Nolan Slough, and a “south levee” south of Hoquarten Slough. These new levees are required hydraulically to protect agricultural properties that are not part of the project area and also to prevent high tides from making flooding upstream worse. When riverine flood flows are combined with a high tide, the tides can “back up” the floodwaters and hold them further upstream. This can make flooding worse in areas such as along Highway 101. The new levees are designed to hold back the high tides while still allowing the high floods to flow over the top. The new levees are required to maximize the flood reduction benefits of the Proposed Action.

Levees would be modified along Hall Slough, Dougherty Slough, and the Trask River (**Figure 3-2**). Most of the new and modified levees would be built to the design elevation of 12 feet NAVD88 vertical datum (North American Vertical Datum of 1988), with some adjustments where they tie into existing levees or higher ground. (NAVD88 vertical datum is a measurement benchmark that allows for consistent measurement of elevations across the project area and for design.) This elevation was selected based on modeling the effectiveness of various elevations and historic tidal data. The objective would be to build as low a structure as possible that would pass river flood flows out of the floodplain while preventing high tides and coastal storm surges from getting into upgradient agricultural lands. If the levees are too high, then there would be an increase in flood elevations in upstream areas. If the levees are too low, then the high tides could overtop them and damage adjacent agricultural lands. The downstream side of each levee would have a 5:1 slope in order to pass overtopping floodwaters with minimal damage.

3.4.1.4 New Flood Control and Drainage Structures

A new high capacity flood control structure would be incorporated in the new middle levee (a short levee segment between Hall and Dougherty Sloughs – see **Figure 3-2**). This new flood control structure would replace the existing gates, provide more conveyance capacity than currently exists, and allow rapid post-flood drainage. The six 6- by 12-foot side hinge gates from the existing flood control structure at the western end of the project area would be reused in the new flood control structure, and an additional four gates would be added to the overall structure. The structure is anticipated to be cast in place concrete with a sheet pile seepage cut off wall. Floodgates are designed to function only during floods; thus, they would be set at the approximate floodplain elevation rather than in a channel. This elevation would vary depending on where in the floodplain a particular structure is located. This also will make the floodgates appear to be "perched" above the downstream channels, but the gates will function when floods are present on the upstream side. The upper end of the relic Nolan Slough channel would be excavated up to the outlet of the new floodgates to serve as the exit channel from the gates. Flood flows would be expected to pass through the gates every second or third year, which would be a sufficient frequency to keep the channel open and able to convey flood flows out to the main river channels and the bay.

In addition, the 5- and 6-foot diameter round floodgates currently located at the western end of the project area would be reused on replacement pipes in the new levees to provide equal or better drainage from adjacent pasture lands. Floodgates in the north levee would use existing or constructed sinuous tidal channels to provide connections to the main river to pass out flood flows. Improvements to existing drainage ditches inside the new levee would be made as necessary to connect them to the new floodgates and ensure equal or better drainage is maintained once the project is implemented. This is expected to be a relatively minor project component, consisting primarily of cleaning existing ditches and excavating some short new connector segments near the new levee.

3.4.1.5 Hall Slough Elements

The Proposed Action would improve the hydraulic connectivity between Hall and Blind Sloughs in order to achieve flood reduction benefits. Providing multiple channels for floodwaters to follow to the bay will increase the capacity of the total system to carry floodwaters. However, the magnitude of that additional capacity is unpredictable because flood flows may deepen and widen the Blind Slough channel, increasing the capacity, or they may deposit sediments, resulting in a decrease in capacity over time. It is not known how this component of the system will respond once natural tidal influences and riverine flood flows are restored.

Under the Proposed Action, all of the road berms inside of the restoration area would be removed. A new connector channel would be constructed to link Hall Slough with Blind Slough (**Figure 3-2**).

3.4.1.6 Habitat Restoration and Other Elements

Habitat restoration activities would generally be limited to removing constructed features that impede the free exchange of tides within the project area. The natural processes linked to the tides are expected to bring in the water, salinity, sediment, and seeds that would initiate natural restoration processes. Once the perimeter levees are removed, it is expected the regular tides will naturally restore the historic side channels that provide habitat diversity. Approximately 14 miles of side channel habitat is expected to be restored in this manner. The project represents restoration of approximately 10 percent of the watershed's historic tidal acreage.

Existing ditches would be filled with onsite materials in order to ensure natural tidal channels can develop without being short-circuited by the linear ditches. Existing relic tidal channels would have existing plugs and culverts removed to allow full tidal access. The few roads on site would have any crushed rock or large gravel surfaces removed, and the roadbed would be de-compacted. In many places in the lower floodplain, levees and roads are indistinguishable because roads need to be elevated to remain functional throughout the year. Therefore, levees and roads are combined under the 6.9 miles of "levee/road removal" shown in **Table 3-2**. Floodgates that would be installed in the new levees, as shown on **Figure 3-2,** would be designed to allow for fish passage in accordance with state regulations as appropriate.

Floodplain connectivity would be restored at approximately 20 locations (**Figure 3-2**) where existing riprap would be removed to reestablish channel connections with the bordering rivers and sloughs, as shown on **Figure 3-6** and **Figure 3-7**. In addition, approximately 2,025 linear feet of riprap would be removed along the north side of the Trask River where the river flows to the north before turning west. This would allow flood flows from the Trask River to move into the project area. Some of the removed rock may be reused on site for new levees or levee modification. Excess rock may be used off site for other projects; however, it could not be used as fill in floodplains or wetlands except as authorized under a CWA 404 permit.

The amount of material (primarily sand and silt) from the levees that are removed would be greater than the amount needed to construct new levees because the new levees would be shorter. Some of the material from the levee and fill removal will be used to fill the drainage ditches in the area to be restored. Excess material would be distributed across the interior of the project area to fill low spots to prevent fish stranding, allow for proper drainage of tides, and to raise subsided areas so that they would more quickly establish marsh vegetation. Some of the material would be placed within the Aufdermauer parcel to improve pasture conditions within this flowage easement area. This area would be reseeded with pasture grasses. The remaining material would be spread within approximately 228 acres of the western portion of the project area. The entire 228 acres would not be covered with excess material. It is estimated that approximately 120 acres might be covered to a depth of about 6 inches.

Photo by Laura Brophy 2007

Figure 3-6. Rising Tide Fills Dike Breach at Siuslaw Tidal Wetland Restoration Project

Photo by Laura Brophy 2007

Figure 3-7. Spring High Tide Fills Pilot Channel at Siuslaw Tidal Wetland Restoration Project

Once restored to a tidal regime, the resulting range of habitats is expected to include mud flats, aquatic beds, emergent marsh, scrub-shrub wetlands, forested wetlands, and sloughs. The habitat restoration component of the project is targeted at improving conditions for the threatened coho, and other salmonids, including chum and Chinook salmon and cutthroat trout.

3.4.1.7 Demolition and Removal of Contaminated Material

The Proposed Action would require the demolition of five buildings. In addition, cleanup of soil contamination found at the Sadri property would be required.

There is a complex of farm buildings consisting of two loafing sheds, a milk parlor, a covered manure storage structure and a machine shed near Goodspeed Road, and one residence near the Wilson River that would be demolished and materials recycled or disposed at an approved permitted landfill outside the floodplain. There is one house near Goodspeed Road and Hall Slough, shown as proposed for removal, which might be retained because it would be on the upgradient side of the new levee. Two other buildings shown on **Figure 3-2** on the banks of the Trask River were previously demolished and disposed; however, the slab foundations remain, and their volumes are included in the volumes presented in **Table 3-3**.

The removal of fill at the Sadri property would result in removal of approximately 20,000 cubic yards (cy) of potentially contaminated soil. Approximately 300 cy would need to be disposed of at the Waste Management landfill in Hillsboro, Oregon, located 65 miles east of Tillamook because it is contaminated with heavy oil. There are three options under consideration for the disposal of the remainder of the contaminated material. Based on contaminant levels, most of this material would be suitable for re-use as fill in upland areas on site with additional controls, such as an impermeable liner or cap, to further limit erosion and migration of contaminants into sensitive ecological environments and limit human exposure to the contaminated material. Therefore, disposal could occur on site, at another upland location within the County, or it could be disposed of at the landfill in Hillsboro, Oregon. If the material were consolidated on site, it would be moved to the City-owned property to the east of the Sadri parcel and capped. This consolidation area would be raised approximately 3.4 feet in elevation and completed with a parking lot and day use visitor area for public recreational use. The parking lot would be approximately 2 acres in size and include a ramp or dock to provide boat access to Hoquarten Slough for kayaks and small boats.

3.4.2 Construction and Maintenance

Actual construction methods would be determined by the construction contractor and subject to permit conditions, but details on proposed construction methods, material and construction waste quantities, construction equipment, staffing, and schedule are detailed in this section and summarized in **Table 3-3**. It is assumed all of the construction equipment and staff would be needed throughout the duration of the main construction period of May through October 2016 (**Table 3-3**).

Table 3-3. Alternative 1 Construction Details

Item	Value
Construction equipment	Excavators – 4 Off-road dump trucks – 6 Scrapers – 2 Front end loader – 1 Sheepsfoot vibratory roller – 2 Bulldozer – 2 Standard dump truck with trailer – 4
Imported materials (cy)	Crushed rock base course – 7,600 cy Asphalt [2] – 150 cy Hog fuel [1] – 10,000 cy
Exported/Disposed material	Soil – 10,000 cy Concrete – 110 tons Demolition waste – 1,600 tons
Building demolition	Buildings demolished – 5 Size of demolished buildings – 32,600 square feet (sq ft)
Area graded [3]	179 acres
Cut/Fill volumes	Cut – material removed from levees and other excavation [4] – 195,000 cy Fill – material to be placed on site for: • New levees – 114,000 cy • Fill ditches – 27,000 cy
Construction staffing	Clearing/grubbing – 4 workers Demolition – 2 workers Excavation – 6 workers Grading – 2 workers Levee construction – 6 workers
Excavated/fill material storage	1 acre (size of temporary/permanent fill piles)

1 – "Hog fuel" is coarse wood chips used as temporary road bed for construction equipment. It may be partially removed upon completion of the work or left in place because it biodegrades.

2 – Asphalt would be used to repair existing roads potentially damaged by construction.

3 – Grading includes grading for new levees (approximately 10 acres), fill removal (approximately 42 acres), excess fill disposal (approximately 120 acres), and miscellaneous activities (e.g., haul roads, access points, and turnarounds) (approximately 7 acres).

4 – Cut material does not include material excavated to create new channels.

Most of the site work would be conducted with standard heavy earthmoving equipment, including excavators, off-road dump trucks, and scrapers. Some areas, particularly those on either side of Hoquarten Slough and in the center of the northern area, may require tracked dump trucks and lighter weight equipment due to wet soil conditions. Although unlikely, a barge may be used in the larger channels to move material within the project area.

There may be more material removed from the levees on one side or the other of Hoquarten Slough than is needed to construct new levees on that side; therefore, material may need to be transported between the north and west portion and the south portion of the project area. One construction option would be to use a temporary trestle or pontoon bridge across the Slough. A more likely option would be to haul the necessary material out onto Highway 101 and then through town to the southern portion of the site. This option avoids bridge costs but would incur additional roadway repair and other costs from use of public streets and may have traffic impacts.

Construction sequencing would be critical for implementation of the Proposed Action. While the existing levees and fill would provide a source of material for new levee construction and ditch filling, the project area must also remain protected from tides until this work is substantially completed along with other interior work such as road decommissioning. In coordination with the permitting agencies, approved fish exclusion devices would be installed and floodgate mitigation devices would be repaired or removed prior to beginning construction in order to temporarily maximize site drainage and make equipment access possible to the wetter areas, primarily for ditch filling. The proposed fill removal would occur in stages, as shown in **Figure 3-8**, with the bulk of the material removed to an elevation that is just above the summer high tides, which would allow virtually all the levee and fill removal and new levee construction work to occur out of the water. The final fill removal needed to achieve the final design elevations would be timed around the tides and occur during low tide periods. The final elevations would be designed to mimic natural marsh elevations observed at nearby sites. Existing roads would be utilized, and new temporary haul roads would be constructed, as needed, to facilitate efficient haul loops and use of equipment. A proposed schedule is shown in **Table 3-4**.

Photograph by Jesse Barham, USFWS

Figure 3-8. Levee Fill Material Removed in Stages at Nisqually Tidal Wetland Restoration Project

Table 3-4. Proposed Construction Schedule and Sequence for the SFC – Landowner Preferred Alternative

Activity	Schedule	Notes
Site Preparation	**Jan-Aug 2016**	
Select Tree Felling	Jan 2016	Avoid Marbled murrelet and other migratory bird nesting season
Construct/Upgrade Haul Roads	Apr-Jun 2016	
Clear and Grub	May-Aug 2016	Occurs concurrently with other activities
Perimeter/Dry Area Work	**May-Sep 2016**	
Demolition	May-Jun 2016	Existing structures removed
Excavation	May-Sep 2016	Remove existing fill, leaving small berm to exclude tides from site
Pre-load Select Areas	May-Jun 2016	Pre-load middle levee floodgate area to accelerate settlement
New Levees	**Jul-Sep 2016**	
New Levee Construction	Jul-Sep 2016	
New Tide/Floodgate Construction	Aug-Sep 2016	In concert with new levees
Interior Wetland Restoration	**Jul-Oct 2016**	
Remove channel blockages	Jul-Aug 2016	Interior culverts, fill plugs
Ditch Fill	Jul-Aug 2016	
Tidal Channel Excavation	Jul-Aug 2016	
Grading	Aug-Oct 2016	Re-use organics, grade pasture areas
Complete Erosion Control Measures	Aug-Oct 2016	Temporary and permanent measures
Final Breaching	**Oct 2016**	
Breach Perimeter Levee	Oct 2016	Breach and demobilize for the winter
Project Closeout	**Jul – Sep 2017**	
Final Levee Grade Adjustment	Jul-Aug 2017	Minor new levee adjustments to meet final grade post settlement
Project Closeout	Sep 2017	

Construction of new levees would consist of stripping and stockpiling organic topsoils, excavating any soft or unsuitable soils in the subgrade, compacting the subgrade, and constructing the levee proper. New levees would be constructed with materials salvaged from the removal of existing levees and fill. Organic topsoils salvaged from the footprint of the new levee and from materials removed from elsewhere on the site would be placed on the side slopes of the new levees. All exposed surfaces would be hydroseeded to stabilize the new levees quickly. Each levee would be topped with an all-weather, crushed rock driving surface.

In some areas, the underlying soils would be likely to compact under the weight of the new levee materials more than in other areas. In these places, the new levee might be "pre-loaded," which is a process where excess material is added to the structure to increase its weight and accelerate the compaction of the subgrade material. Once the new structure has settled, any remaining excess material would be removed and the levee sides and top finished. Alternatively, the new levees may simply be constructed taller than the final design height to account for the expected settling, which would likely occur over a year. Minor adjustments would then be made to ensure the new levees meet the design specifications along their entire length once settling has occurred.

Once the new levee and floodgates are constructed and all other interior work completed, the remaining existing levees and fills could be removed. Existing roads would be decommissioned and equipment access restricted to the perimeter of the site. Ultimately, the levees must be breached, at which point removal of the remaining fill would become much more difficult. Final excavation would require working within tide cycles, working back out of the project site without the benefit of loop haul roads, and more complex sediment control measures. However, the excavation quantities at this final stage would be expected to be small.

Grading would be required to accomplish several of the activities. Construction of new levees would result in grading of about 10 acres, and the removal of levees and fill would result in approximately 42 acres of grading. The removed levees and fill are expected to result in some excess material that is not needed for construction of new setback levees, and this material would be spread on pastures to raise the elevations up to a level more suitable for tidal marsh development. The disposal of this excess material on pastures would require approximately 120 acres of grading to spread the material appropriately. It is assumed there would be an additional 7 acres of miscellaneous grading for activities such as haul roads, access points, or turnarounds.

Erosion control measures and other construction best management practices (BMPs) would be required because large areas would be disturbed by excavation, access roads, and the spreading of excess material on site. Erosion control measures and other BMPs would conform to those required by the Programmatic Restoration Opinion for Joint Ecosystem Conservation by the Services (NMFS 2013a) and other regulatory agencies such as Oregon Department of Environmental Quality. These measures are described under the appropriate sections in the EIS. For example, erosion control measures are described under Section 4.7.1 on soils.

With implementation of this alternative, long term maintenance requirements on public lands and levees would be expected to be lower than under the existing condition. Approximately 45,000 feet of levee, including 30,000 feet that run along river channels and are currently exposed to higher erosive stresses, would be replaced with 7,000 feet of new, wider, engineered levee, very little of which would be near any channel. New floodgates would be constructed of corrosion resistant materials and have a longer life span than the older steel structures now in use. Annual maintenance would consist of levee and floodgate inspection and mowing of the levee slopes. The County, SWCD, and TBHEID would continue to be responsible for annual maintenance of levees.

Project infrastructure requiring long-term maintenance would include approximately 1.4 miles of setback levees and eight associated floodgates. This represents approximately 5.5 miles less of levees and about five fewer floodgate structures to maintain. Floodgate seals and bearings are estimated to have a life of 10 years. The new levees would be set back from the river channel, built at a low height (most of the system would be only 4 to 6 feet high), and designed to overtop and allow floodwaters to exit to Tillamook Bay without significant damage under frequent flood conditions.

The estimated costs for land acquisition, site investigations, baseline monitoring, design, construction, and wetland restoration are approximately $10 million. Annual maintenance costs are estimated to be approximately $20,000, with an additional allowance of $150,000 every 10 years for less frequent repairs and maintenance. It is expected annual maintenance costs would continue to be shared by the County, TBHEID, SWCD, and ODFW as they currently are. Costs for major repairs would also be shared between the County and TBHEID. Annual maintenance costs include an allowance for monitoring of restoration success, which is not part of the annual maintenance costs under the No Action Alternative. Annual monitoring would be conducted for 5 years. The Proposed Action has a design life of 40 to 50 years, but with appropriate maintenance, the infrastructure may last longer.

3.5 Alternative 2: Hall Slough Alternative

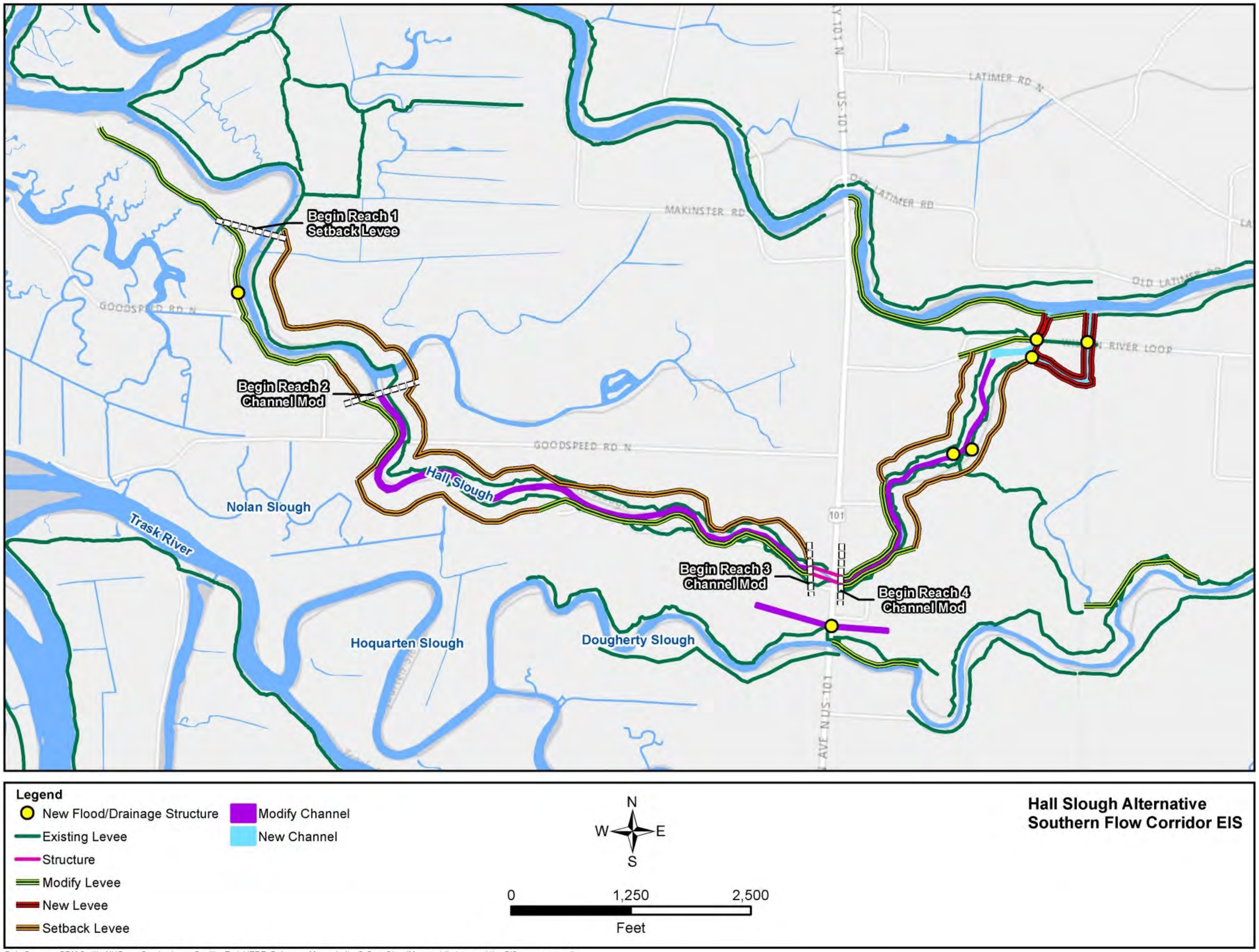
Hall Slough is a side channel of the Wilson River that begins upstream of Highway 101 near the Wilson River Loop Road and ends downstream approximately 1.5 miles east of the mouth of the Wilson River. Hall Slough was connected to the Wilson River at its upstream end before 1950. At that time, a bridge was in place that crossed Hall Slough on the Wilson River Loop Road. Since then, the slough has become disconnected from the Wilson River, the bridge removed, and a small culvert was placed under the Wilson River Loop Road to drain the area behind it (Levesque 2013). This area is near where the Wilson River overtops first during a flood event. Floodwaters overflow along the left bank of the river near the historic Hall Slough entrance and then down the Wilson River Loop Road to Highway 101. At the highway, floodwaters flow south along the highway and eventually cross and inundate the highway. These types of floods occur frequently and could be addressed by reestablishing connection between Hall Slough and the Wilson River (Levesque 2013).

3.5.1 Alternative 2 Features

As detailed in **Table 3-5** and shown on **Figure 3-9**, the Hall Slough Alternative would reconnect the upper end of Hall Slough to the Wilson River. Approximately 6.3 miles of levees along the channel length would be set back or modified (approximately 3 miles each), and approximately 1.9 miles of the channel would be widened and deepened. This alternative would increase the capacity of Hall Slough to allow it to carry some floodwaters out to Tillamook Bay.

Hall Slough is not large enough to contain all the floodwater that may overflow from the Wilson River, but it could contain flows of up to about 1,000 cfs, which is approximately the amount of overflow that occurs with an annual flood. These nuisance floods that occur every 1 to 2 years disrupt traffic on Highway 101 and could be completely controlled under this alternative (Levesque 2013). This alternative would not provide flood hazard reduction for all floods, but it would eliminate the common “nuisance” floods in the Highway 101 area.

The alternative would provide a channel for floodwaters that overtop the Wilson River in the area of the historic confluence of the river and the slough. This alternative is primarily designed to reduce flooding and flood impacts with an ancillary wetland and riparian habitat restoration of approximately 90 acres in the area between the setback levees and the new widened channel where tidal wetlands could form. Under this alternative, tidal effects would reach nearly to the upstream end of the slough. The Hall Slough Alternative would provide fish and wildlife habitat benefits and improve fish passage, ecosystem and floodplain function, and water quality.



Data Sources: CDM Smith, NHC Service Layer Credits: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Figure 3-9. Alternative 2: Hall Slough Alternative

Table 3-5. Hall Slough Alternative

Alternative Feature	Change From Existing Condition[1]
Channel construction	0.4 miles
Channel modification	1.9 miles
Wetland restoration[2]	90 acres
Levee/road removal[3]	0.0 miles
Levee modification[4]	6.3 miles
New levee[5]	0.7 miles
Flowage easement	0.0 acres
Drainage ditches filled	0 miles

1 – Measurements provided in this EIS are based on independent GIS measurements and may vary slightly from values reported in previous project-related documents.

2 –Wetland restoration area includes all areas where natural tidal hydrology would be restored after excluding the channel area.

3 – Levee/road removal includes the removal of areas of dredge spoils that impede tidal hydrology.

4 – Levee modification includes areas where existing levees would be setback, strengthened, and/or raised along the Hall Slough channel.

5 – New levees would include new levees constructed in locations where there currently are no levees, particularly along the new channel constructed to connect Hall Slough with the Wilson River.

Although the Hall Slough Alternative would not include any work in the SFC project area, similar to the No Action Alternative, the County would retain ownership of the 392 acres previously purchased. The terms of the grant funding under which the County purchased the property prohibit continued agricultural uses. Therefore, it is reasonable to assume that although the levees would not be reconfigured, agricultural operations (grazing and hay production) would be phased out over time on the 392 acres in County ownership.

3.5.1.1 New Levees and Levee Modification

The levees along Hall Slough would be set back or modified as follows:

- In Reach 1, starting from about 300 feet downstream of Goodspeed Road, the right bank levee would be set back about 150 feet. The levee on the left bank would be strengthened.
- In Reach 2 and Reach 4, existing levees would be set back up to 150 feet where there are no existing structures. Where there are existing buildings and structures, the levees would remain in their existing locations, and the setback levees would curve between the existing locations to the new setback locations.
- In Reach 3, the levees would not be changed.
- New levees would be constructed along the new channels in Reach 4 to connect the upper end of Hall Slough to the Wilson River.

In all reaches, the levees would be modified so they are a consistent height. In many areas, the levees have settled over time, and there are stretches that are now lower than the design height.

In most cases, this modification would only require the addition of 1 to 2 feet in height. There would be no change in the width of the levees.

In addition to the levees along Hall Slough, the levee on the south side of the Wilson River downstream of the new confluence of Hall Slough and the Wilson River would be modified. The modifications would consist of minor increases where necessary to achieve a consistent height of greater than 15.4 feet elevation, which would be the height at which flows would be directed into Hall Slough. The levee would be raised to prevent flows that should be directed into Hall Slough from overtopping the levee immediately downstream of the new connection. The Hall Slough Alternative is designed to address the 1- to 2-year flood events, which frequently flood over Highway 101.

This alternative also includes a very short segment of modified levee along Dougherty Slough to the east of the main project area. This modified levee segment is shown on the eastern edge of **Figure 3-9**. This segment would be raised to contain floodwaters in Dougherty Slough for at least the small, high frequency flood events this alternative is designed to address. These flood events may occur as often as every 2 years. Another segment of levee along Dougherty Slough would also be modified to raise its elevation to a consistent height just south of the proposed swale under Highway 101. This modification would direct minor flows associated with 1- to 2-year flood events toward the swale.

The wider channel and setback levee locations would require a number of property acquisitions or easements although no structures would be directly affected. The Hall Slough Alternative would affect approximately 22 parcels with setback levees and require approximately 96 acres of land acquisition for the channel widening and levee setbacks (**Figure 3-10**). Approximately 2 acres of the Hall Slough project area is already in County ownership at the far western end of the project area, and another 20.7 acres are the existing surface waters of Hall Slough.

Under the Hall Slough Alternative, there would be no levee or fill removal in the SFC project area.

3.5.1.2 New Flood Control Structures and Drainage Structures

The Hall Slough Alternative would deepen the slough to maintain a positive slope to the bay and to be tidally active throughout its length. An overflow or weir structure would be placed at the slough's upper end to allow flows from the Wilson River to enter Hall Slough when the river reaches an elevation of 15.4 feet. In order to keep these increased flows within the slough, the slough would be widened and deepened from its upstream end down to the Goodspeed Road bridge. The Hall Slough bridge at Highway 101 would be lined with vertical concrete walls and deepened to pass flows of 1,000 cfs. Hall Slough downstream of Goodspeed Road would be unchanged.

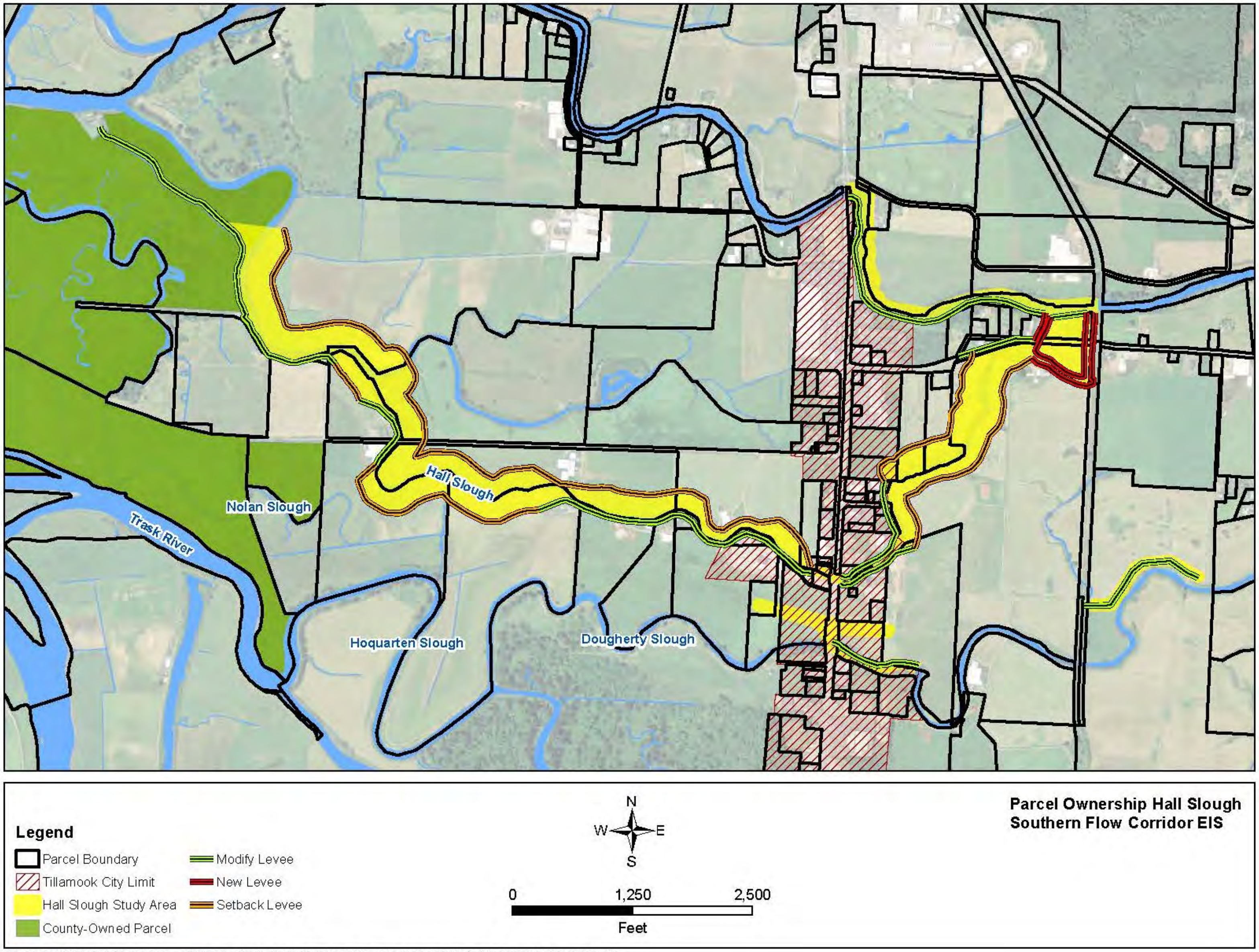


Figure 3-10. Parcels Potentially Affected by Hall Slough Alternative

The Hall Slough channel would be modified as follows:

- In Reach 1, the slough channel would not be modified because it is already wide and deep enough to carry the design flow of 1,000 cfs.
- In Reach 2, the channel would be deepened and widened to approximately 100 feet wide at the top.
- In Reach 3, the channel would not be widened, but it would be deepened, and vertical walls would be constructed to pass flows under the existing Highway 101 bridge. The bridge would not be changed.
- In Reach 4, the channel would be widened and deepened to 75 feet wide at the top. New channel would be constructed at the upper end to connect Hall Slough to the Wilson River.

This alternative would include several new floodgate or drainage structures. Three new box culverts and three floodgate structures in the upstream end of Hall Slough and one floodgate at the downstream end would be constructed as shown on **Figure 3-9**. The box culverts are intended to convey flows under roads. The floodgate structures in the upper channel are intended to allow floodwaters from larger flood events that overtop the levee system to drain from surrounding lands into the slough as floodwaters recede. The structure at the downstream end of Hall Slough would allow floodwaters from the channel to exit onto County property near Blind Slough.

In addition, a new swale and drainage structure would be constructed under Highway 101 between Hall and Dougherty sloughs. This is a low area where floodwaters currently find a way over the highway. The combination of increased capacity in Hall Slough with a conveyance under the highway in this low area would virtually eliminate all of the small, high frequency flood events. These small, high frequency flood events may occur as often as every 2 years.

3.5.1.3 Habitat Restoration and Other Elements

Habitat restoration would be limited to riparian plantings in the area at the downstream end of Hall Slough between the slough and the modified levee on the south bank on County-owned property. Where the levees are set back, the resulting terrace between the base of the levee and the top of the channel would be allowed to revegetate and would be expected to develop riparian and wetland habitats. There are approximately 98 acres between the setback levees, excluding channel surface area. The additional riparian plantings would improve habitat conditions in the channel for salmonids and bird species that may use the area.

Because there would be no levee removal in the SFC area, the property previously purchased by the County for tidal wetland restoration would not be restored to tidal wetlands. As the existing agricultural leases are phased out in conformance with the grant requirements under which the property was purchased, it may be expected that much of the area would convert to freshwater wetlands.

3.5.1.4 Demolition and Removal of Contaminated Material

The Hall Slough Alternative would not require the demolition of any buildings or structures. The levee setbacks would be adjusted to avoid existing structures. As described for the No Action Alternative, the County would discontinue acquisition and cleanup efforts associated with the purchase of the Sadri property.

It is expected that most of the material for the setback levees would come from the existing levees. Based on soil sampling conducted on area levees for the Proposed Action, it is expected that most of the material from the existing levees would be suitable for re-use in the setback levees.

The Hall Slough alternative would involve a considerable amount of dredging of the channel to deepen and widen it. It is expected that the dredged material, once dewatered, would be suitable for use in the levees because dredged materials from the sloughs provided much of the material currently in the levees. Because the setback levees are slightly longer than the existing levees and because there would be some new levees constructed at the upper end of the slough, more material would be needed than is in the existing levees. Additional material may also be needed to raise low spots in the existing levees to achieve a consistent height. The dredged material and material excavated to create the new channels would be used on site to modify and set back existing levees and to construct new levees.

Because this alternative has only been developed to a conceptual level, it is unknown how much dredged material might be needed for construction. The length of the levees to be constructed or modified is used as a proxy for potential volumes, and length is used to compare alternatives to each other. It is possible that either some new material might need to be imported or that some dredged material might need to be disposed of. It is assumed dredged material would not be contaminated and could be reused on site or sold as fill to offsite locations.

3.5.2 Construction and Maintenance

Construction of the new setback levees would use material from the existing levees. Actual construction methods for development of the Hall Slough Alternative would be determined by the construction contractor, subject to permit conditions, but it is assumed construction methods, equipment, and staffing would be similar to those proposed for the Southern Flow Corridor-Landowner Preferred Alternative. Because the length of the levees to be constructed, modified, or set back is approximately half that of the Proposed Action, it is assumed the material quantities needed and the duration of construction would also be approximately half of that required for the Proposed Action.

Unlike the Proposed Action, the Hall Slough Alternative would not involve the demolition of any structures and is unlikely to require the removal of contaminated material. However, the Hall Slough Alternative would involve the dredging of approximately 1.9 miles of channel to widen and deepen the slough to carry 1,000 cfs. This could greatly increase the number of trips or the number of trucks needed to remove this material from the project area. The number of flood control and drainage structures proposed under this alternative is similar to the number proposed under the Proposed Action (seven structures compared to eight structures). Assumptions for construction equipment, materials, staffing, and schedule are summarized in **Table 3-6**.

Table 3-6. Alternative 2 Construction Details

Item	Value
Construction equipment	Excavators – 4 Off-road dump trucks – 6 Scrapers – 1 Front end loader – 1 Sheepsfoot vibratory roller – 1 Bulldozer – 2 Standard dump truck with trailer – 4
Imported materials	Crushed rock base course – 3,800 cy Asphalt – 75 cy Hog fuel [1] – 5,000 cy
Exported/Disposed material	Soil – 0 cy Concrete – 0 tons Demolition waste – 0 tons Sediment from channel dredging – 21,000 cy [2]
Building demolition	Buildings demolished – 0
Grading (acres) [4]	35 acres (approximate)
Cut/Fill volumes [4]	Cut – material removed from levees [3] – 500,000 cy Fill – material to be placed on site for: • Setback levees – 500,000 cy • New levees – 56,000 cy
Construction staffing	Clearing/grubbing – 4 workers Demolition – 0 workers Excavation – 6 workers Grading – 2 workers Levee construction – 6 workers
Excavated/fill material storage	1 acre (size of temporary/permanent fill piles)

1 – "Hog fuel" is coarse wood chips used as temporary road bed for construction equipment. It may be partially removed upon completion of the work or left in place because it biodegrades.

2 – Calculation based on assumptions presented in USACE 2004a. Does not include material excavated for new channels.

3 – Assumes setback levees would be constructed with material from existing levees.

4 – Volumes based on proportional comparisons with the volumes estimated for work under the Proposed Action.

The construction sequence and activities would be similar to those described for the Proposed Action. However, since there would be considerable work in the channel, extra precautions to prevent turbidity and sedimentation from spreading downstream would need to be taken in addition to erosion control measures and other BMPs. These could include water diversions and exclusion devices to ensure aquatic species cannot enter the work area. Dredging could be conducted from the banks and would not require equipment to enter the water except potentially where new structures are proposed. Provisions would be made to appropriately dewater sediments dredged from the channel. These may include the use of geotextile tubes to allow water to migrate through a membrane while retaining sediments or the use of filter presses or other similar equipment to expel water while collecting solids. Use of dredged material is described in Section 3.5.1.4.

Work in the channel and construction of instream structures likely would need to be completed within one in-water work window, but the levee setback portion of the project would not be constrained by seasonal considerations. It is assumed the Hall Slough Alternative could be constructed within one construction season. Grading work would be limited to removal of the old levees, construction of the new setback levees, and miscellaneous needs such as construction of access roads.

Maintenance of the flood control and drainage structures would be similar to the maintenance requirements described under the Proposed Action. The levees likely would require less maintenance because they are largely oriented parallel to flood flows rather than crosswise to them. Therefore, the levees are not designed to accommodate overtopping flows on a regular basis. It is assumed this would result in a lower frequency of required maintenance on the levees. The Hall Slough Alternative would require periodic dredging to maintain the design channel depths and widths. It is unknown how frequently the channel would need to be dredged, but it is possible dredging would be needed as frequently as every 2 to 5 years based on reported historical dredging frequencies (Levesque 2010). Dredging would be conducted with a barge-mounted crane.

The estimated cost for site investigations, design, construction, and habitat restoration was approximately $7.5 million in year 2000 dollars. This cost has not been adjusted for inflation or other changes in costs and it did not include baseline monitoring; therefore, it is not directly comparable to the costs presented for the Proposed Action. The cost of this alternative also does not appear to include acquisition costs. While the acreage needed for the setback levees is less than the acreage acquired under other alternatives, there would be many more landowners to negotiate with, which could make implementation more difficult.

Annual maintenance costs were not estimated; however, they likely would be higher than for either the No Action or the Proposed Action alternatives. The Hall Slough Alternative would require periodic maintenance dredging that would be an additional expense not incurred under the other alternatives and would be in addition to levee and floodgate structure maintenance.

The existing maintenance costs for levees along Hall Slough would remain because the setback levees would be essentially the same length in essentially the same position with respect to the channel. They may be subject to slightly less erosive forces, and the new setback levees would be engineered to be more stable, which may result in slightly lower maintenance costs.

However, there would be approximately 0.7 miles of new levee, seven new floodgate structures, and an overtopping weir at the Wilson River that would require maintenance. Although, new floodgates would be constructed of corrosion resistant materials and have a longer life span than the older steel structures now in use, there would be more of them within the study area. An allowance of $150,000 every 10 years for less frequent repairs and maintenance likely would be needed for the seven new floodgate structures. Under the Hall Slough Alternative, the facilities in the SFC area would remain unchanged, and the maintenance costs associated with that area as described for the No Action Alternative would continue. Therefore, the total maintenance costs to the County, drainage districts, and others responsible for levee and floodgate maintenance would be greater than under other alternatives. Annual maintenance would consist of levee and floodgate inspection and mowing of the levee slopes.

3.6 Alternative 3: Southern Flow Corridor – Initial Alternative

As described in Section 3.1, the Southern Flow Corridor – Initial Alternative was developed as a part of the Oregon Solutions Project and shares a number of characteristics in common with the Proposed Action although it features somewhat different levee, floodgate, and drainage network configurations (**Figure 3-11**). This alternative would also function in a similar fashion to the Proposed Action in that it would also remove manmade impediments to flood flows in the lower Wilson River floodplain and restore tidal wetlands and channels.

3.6.1 Alternative 3 Features

As detailed in **Table 3-7**, the Southern Flow Corridor – Initial Alternative would restore approximately 568 acres of wetland and remove 8.82 miles of levees. About one half mile of levee would be reconfigured to protect agricultural lands in the lower delta from tidal inundation.

Table 3-7. Southern Flow Corridor – Initial Alternative

Alternative Feature	Change From Existing Condition[1]
Channel construction	0.2 miles
Natural channel restoration[2]	14 miles [2]
Wetland restoration[3]	568 acres
Levee/road removal[4]	8.8 miles
Levee modification[5]	0.7 miles
New levee[6]	1.6 miles
Flowage easement	0.0 acres
Drainage ditches filled	3.3 miles

[1] – Measurements provided in this EIS are based on independent GIS measurements and may vary slightly from values reported in previous project-related documents.

[2] – Natural channel restoration is the length of historic side channel habitat expected to reform with the reintroduction of tidal hydrology. Under this alternative, the length of restored channel would be expected to be greater than 14 miles because levees surrounding an additional 86 acres would be removed as compared to the Proposed Action. However, relict channels are not as visible in this area on aerial photography so it is more difficult to estimate how much new channel restoration would occur.

[3] – Wetland restoration area includes all areas where natural tidal hydrology would be restored.

[4] – Levee/road removal includes the removal of areas of dredge spoils that impede tidal hydrology.

[5] – Levee modification includes areas where existing levees would be strengthened and/or raised and where existing levees would be lowered.

[6] – New levees would include new setback levees or levees constructed in locations where there currently are no levees.

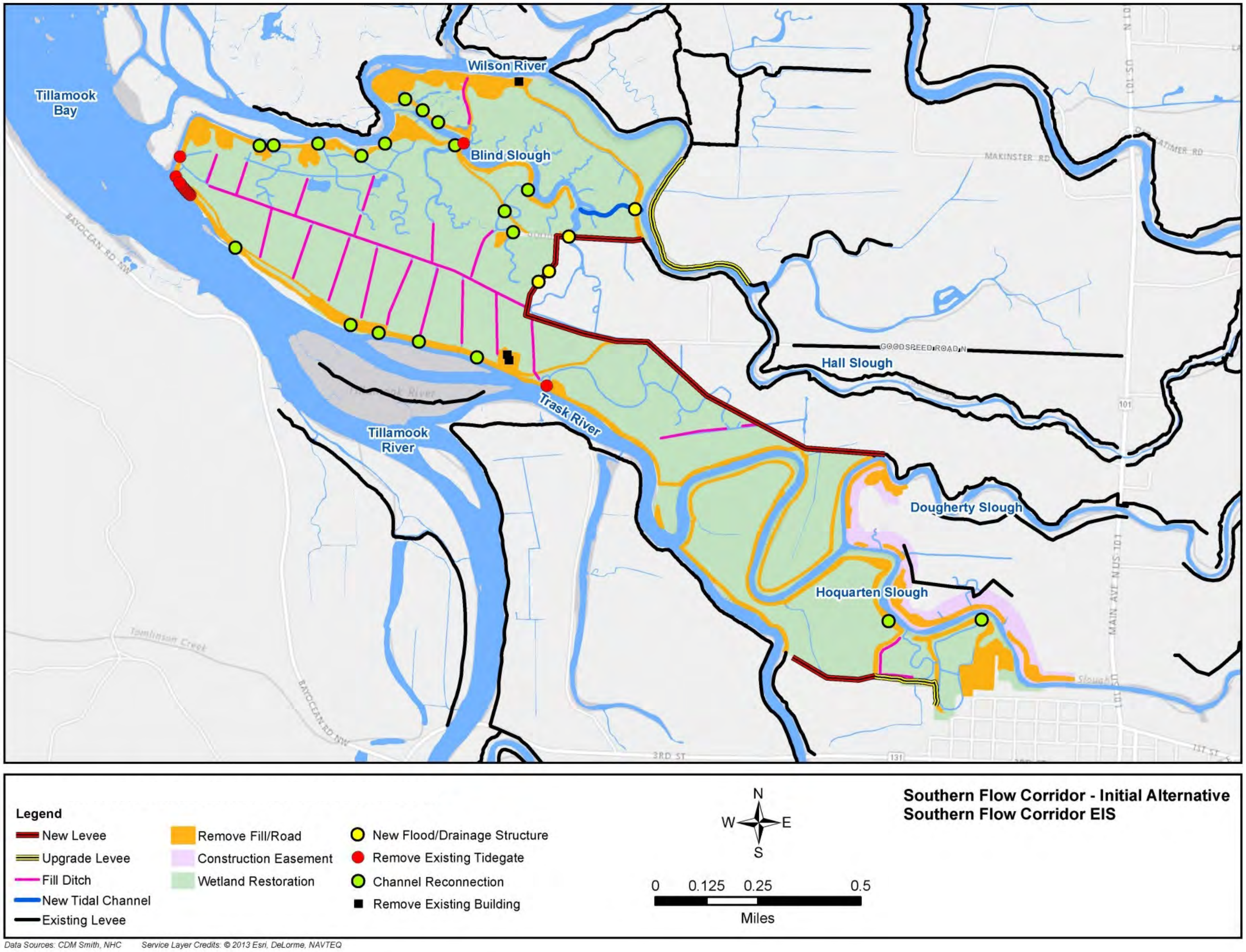


Figure 3-11. Alternative 3: Southern Flow Corridor – Initial Alternative

Property acquisition under Alternative 3 would be similar to the Proposed Action with some exceptions. The County and POTB would only acquire approximately 4.8 acres from two property owners to consolidate the public holdings at the western end of the project area. The Sadri property and a portion of the southern Jones' parcels would be acquired (see **Figure 3-5** for property locations). The Aufdermauer and Beeler properties would be purchased in fee for habitat restoration rather than remaining in agricultural uses with a flowage easement. These acquisitions would increase County and POTB holdings by approximately 183 acres. None of the public lands would be leased out for agricultural uses. The 5.6 acres of City property in the southeastern corner of the project area would be included in the habitat restoration activities. Finally, another 35-acre construction easement would still be required along Dougherty and Hoquarten sloughs (**Figure 3-11**). This alternative would require more land acquisition, and some parcels, notably the Jones parcels, would be only partially acquired as compared to the Proposed Action.

3.6.1.1 Levee and Fill Removal

Removal of the numerous levees and fills within and around the edges of the project area would increase the conveyance capacity that provides a reduction of flood elevations over a wide area of the lower Wilson River floodplain. Levee, road, and fill removal is shown in orange on **Figure 3-11**. In general, material would be removed to slightly below natural floodplain/marsh level. The removed fill would be used for the new levees if it meets geotechnical specifications and for filling drainage ditches within the restoration area. Any remaining fill would be spread on site in subsided areas to speed restoration of natural salt marsh elevations or offered to adjoining farm operations to be spread over existing pastures.

Vegetation and tree removal would be similar to that described for the Proposed Action.

3.6.1.2 New Levees and Levee Modification

New levees would be constructed to protect agricultural lands from storm surges and high tides. These areas are shown in red on **Figure 3-11**. Most of the new and modified levees would be built to the design elevation of 12 feet NAVD88, with some adjustments where they tie into existing levees or higher ground. This elevation was selected based on modeling the effectiveness of various elevations and historic tidal data. The objective would be to build as low a structure as possible that passes river flood flows out of the floodplain while preventing high tides up to the mean higher high tide (a 20-year average of the higher of the daily high tides) from getting into upgradient agricultural lands. The downstream side of each levee would have a 5:1 slope in order to pass overtopping floodwaters with minimal damage.

3.6.1.3 New Flood Control and Drainage Structures

A series of new floodgates would be incorporated in the new levee in order to replace the existing gates. The 10 existing 6-foot-diameter round gates and four 5 by 12-foot side hinge gates on the existing spillway structure at the western end of the project area would be reused on replacement pipes and structures in the new levee. In addition, a new spillway structure would be constructed. Gate locations would be distributed in existing relic tidal channels along the new levee alignment, primarily near Blind and Nolan sloughs. Additional gates would discharge directly into Dougherty Slough. Gate locations outside of channels would be avoided to avoid burial as the project area downstream of the levee rebuilds to natural marsh levels. Flood flows would be expected to pass through the gates every second or third year, which would be a sufficient frequency to keep the channels open and able to convey flood flows out to the main river channels and the bay.

3.6.1.4 Hall Slough Elements

The Southern Flow Corridor – Initial Alternative would improve the hydraulic connectivity between Hall and Blind Sloughs to improve flood reduction benefits. This is would be accomplished by removing the road berms and construction of a Hall Slough – Blind Slough connector channel (**Figure 3-11**). Additional work on the road would involve removal of the road and demolition of the house on the Wilson River. The levee on the right bank of the lower end of Hall Slough would be raised slightly and strengthened where high tides currently overtop it (**Figure 3-11**).

3.6.1.5 Drainage Network Improvements

Improvements to the existing drainage ditches inside the new levee would be made as necessary to connect them to the new floodgates and ensure that equal or better drainage is maintained once the project is implemented. This is expected to be a relatively minor project component consisting of cleaning existing ditches and excavating some short new connector segments near the new levee.

3.6.1.6 Habitat Restoration and Other Elements

Habitat restoration activities would generally be limited to removing constructed features that impede the free exchange of tides within the project area. The natural processes linked to the tides are expected to bring in the water, salinity, sediment, and seeds that would initiate natural restoration processes. Once the perimeter levees are removed, it is expected the regular tides will naturally restore the historic side channels that provide habitat diversity. More than 14 miles of side channel habitat is expected to be restored in this manner. This alternative would result in the restoration of more miles of side channel habitat because levees would be removed from an additional 86 acres (the area included in a flowage easement under the Proposed Alternative). The project represents restoration of approximately 10 percent of the watershed's historic tidal acreage.

Existing ditches would be filled with onsite materials in order to ensure natural tidal channels can develop without being affected by the linear ditches. Existing relic tidal channels would have existing plugs and culverts removed to allow full tidal access. The few roads on site would have any crushed rock or large gravel surfaces removed and the roadbed would be de-compacted. Floodgates that would be installed in the new levees, as shown on **Figure 3-11,** would be designed to allow for fish passage in accordance with state and federal regulations as appropriate.

Channel reconnection at the locations shown on **Figure 3-11** would be similar to that described for the Proposed Action. Floodplain connectivity would be restored by removing existing riprap to reestablish channel connections with the bordering rivers and sloughs, as shown on **Figure 3-6** and **Figure 3-7**. However, the removal of an additional approximately 2,025 linear feet of riprap would not occur under Alternative 3. Rock removed at the channel reconnection points would be reused on site for new levees or levee modification.

The amount of excess material (primarily sand and silt) would be about 20 percent greater than under the Proposed Action because a greater length of levees would be removed and about the same length of new levees would be constructed. In addition, the length of the ditches that would be filled under this alternative would be approximately the same as under the Proposed Action. Excess material would be distributed across the interior of the project area to fill low spots to prevent fish stranding, allow for proper drainage of tides, and to raise subsided areas so that they would more quickly establish marsh vegetation. Because the Aufdermauer parcel would be restored to tidal marsh, excess material placed on this parcel would not be contained within the levee system. Therefore, excess material would be spread over approximately 169 acres in a manner similar to the Proposed Action.

Once restored to a tidal regime, the resulting range of habitats is expected to include mud flats, aquatic beds, emergent marsh, scrub-shrub wetlands, forested wetlands, and sloughs. The habitat restoration component of the project is targeted at improving conditions for the threatened coho, and other salmonids, including chum and Chinook salmon and cutthroat trout.

3.6.1.7 Demolition and Removal of Contaminated Material

The SFC – Initial Alternative would require the demolition of one building and one septic tank. The Diamond J house on the Wilson River would be removed. Two buildings on the bank of the Trask River already have been removed. Other structures would remain under this alternative.

In addition, cleanup of soil contamination found at the Sadri property would be required as described for the Proposed Action. The removal of levees at the Sadri property would result in removal of approximately 20,000 cubic yards of potentially contaminated soil. Based on contaminant levels, most of this material would be suitable for re-use as fill in upland areas on site with additional controls, such as an impermeable liner or cap, to further limit erosion and migration of contaminants into sensitive ecological environments and to limit human exposure to the contaminated material.

3.6.2 Construction and Maintenance

Construction of the Southern Flow Corridor – Initial Alternative would require the same type of equipment and construction sequencing considerations as described in Section 3.4.2 for the Proposed Action. Construction of new levees also would be conducted as described in Section 3.4.2 although they would be placed in slightly different locations. Details on construction methods, material and construction waste quantities, construction equipment, staffing, and schedule are detailed in this section and summarized in **Table 3-8**. Because the total length of levees to be modified, removed, or constructed is approximately the same as for the Proposed Action, it is assumed the requirements for construction equipment and workers, construction duration, and quantities of materials would also be similar. There would be less demolition-related debris as there would be fewer structures removed under this alternative. Construction sequencing would be the same as described for the Proposed Action.

Table 3-8. Alternative 3 Construction Details

Item	Value
Construction equipment	Excavators – 4 Off-road dump trucks – 6 Scrapers – 2 Front end loader – 1 Sheepsfoot vibratory roller – 2 Bulldozer – 2 Standard dump truck with trailer – 4
Imported materials	Crushed rock base course – 7,600 cy Asphalt [2] – 150 cy Hog fuel [1] – 10,000 cy
Exported/Disposed material	Soil – 10,000 cy Concrete – 110 tons Demolition waste – 190 tons
Building demolition	Buildings demolished – 1 Size of demolished buildings – 3,800 sq ft
Grading (acres) [3]	236 (acres)
Cut/Fill volumes [5]	Cut – material removed from levees and other excavation [4] – 234,000 cy Fill – material to be placed on site for: • New levees – 125,000 cy • Fill ditches – 27,000 cy
Construction staffing	Clearing/grubbing – 4 workers Demolition – 2 workers Excavation – 6 workers Grading – 2 workers Levee construction – 6 workers
Excavated/fill material storage	1 acre (size of temporary/permanent fill piles)

1 – "Hog fuel" is coarse wood chips used as temporary road bed for construction equipment. It may be partially removed upon completion of the work or left in place because it biodegrades.

2 – Asphalt would be used to repair existing roads potentially damaged by construction.

3 – Grading includes grading for new levees (approximately 10 acres), fill removal (approximately 50 acres), excess fill disposal (approximately 169 acres), and miscellaneous activities (e.g. haul roads, access points, and turnarounds) (approximately 7 acres).

4 – Cut material does not include material excavated to create new channels.

5 – Volumes based on proportional comparisons with the volumes estimated for work under the Proposed Action.

With implementation of this alternative, long term maintenance requirements on public lands and levees would be expected to be lower than under the existing condition. Approximately 45,000 feet of levee, including 30,000 feet that run along river channels and are currently exposed to higher erosive stresses, would be replaced with 9,600 feet of new wider, engineered levee, very little of which would be near any channel. New floodgates would be constructed of corrosion resistant materials and have a longer life span than the older steel culverts now in use. Annual maintenance would consist of levee and floodgate inspection and mowing of the levee slopes.

Long-term infrastructure maintenance would be similar to that described for the Proposed Action.

The estimated cost for site investigations, design, construction, and habitat restoration was approximately $7.1 million in year 2009 dollars. This cost has not been adjusted for inflation or other changes in costs; therefore, it is not directly comparable to the costs presented for the Proposed Action. The cost of this alternative also does not appear to include acquisition costs or baseline monitoring. Because this alternative would acquire an additional approximately 86 acres for wetland restoration (rather than a flowage easement), it may be assumed the current construction and acquisition costs would be higher than the $10M presented for the Proposed Action. Annual maintenance costs were not estimated; however, because the SFC – Initial Alternative is similar to the Proposed Action, maintenance costs likely would also be approximately $20,000 per year. The County, SWCD, and TBHEID would continue to be responsible for annual maintenance. Alternative 3 would be designed for a design life of 40 to 50 years.

3.7 Other Alternatives Considered and Dismissed from Further Review

This section describes alternatives evaluated but not retained for further consideration based on a comprehensive evaluation in the USACE Feasibility Study (USACE 2005). Levesque (2013) describes the nine alternatives identified by USACE as having both potential flood reduction and habitat restoration benefits in and around the City of Tillamook. These alternatives were modeled in the Feasibility Study (USACE 2005) and included the following alternatives: Wetland Acquisition Area/Nolan Slough, Hall Slough, Lower Trask River, Old Trask River, Dougherty and Hoquarten Sloughs, Lower Wilson River Channel Modification, Lower Wilson River Dredging, Lower Wilson River Channel Modification/Dredging, and Lower Trask and Tillamook Rivers Dredging.

Initial modeling results were presented to the Feasibility Advisory Council and interested citizens on March 27, 2002. Following an evaluation of the initial MIKE11 model results and numerous community and agency discussions, the range of potential alternatives for further study was narrowed to three, including Dougherty Slough, Hall Slough, and Wetland Acquisition with Swale.

The Hall Slough Alternative has been carried forward for further analysis in this EIS. The other two alternatives are described below.

3.7.1 Dougherty Slough

As described in Levesque (2013), the Dougherty Slough alternative would reconnect the slough to its floodplain from Highway 101 downstream to the Trask River. Levees would be removed, and the top 2 feet of soil would be scraped from the banks to reconnect the slough to the floodplain. Riparian vegetation and fencing would be placed adjacent to the slough channel, and some large wood would be placed in the slough for habitat complexity. To achieve more than incidental flood reduction, it would be necessary to increase channel capacity, a measure that would be unlikely to be cost effective. This alternative was not developed further although the study concluded that it remained a viable ecosystem restoration alternative. From the data available, it appears this alternative would not reduce flood damages substantially; therefore, it would be unlikely to meet the purpose and need for the project and was not carried forward for further study in this EIS.

3.7.2 Modified Wetland Acquisition With Swale Alternative

The CCMP identified an objective to acquire and restore 750 acres of inter-tidal wetland habitat in the Tillamook Bay delta area. Following completion of the CCMP, Tillamook County acquired approximately 392 acres of wetland habitat at the tidal interface of the Wilson and Trask rivers. The Modified Wetland Acquisition with Swale Alternative would convert a portion of the 392 acres to tidal marsh and would retain the Wilson parcel in agricultural forage production and as an area for Canada geese (Levesque 2014). This configuration was expected to help to relieve pressure generated by the geese on neighboring agricultural lands (Levesque 2014).

The tidal marsh in the northern portion of the project area would be reconnected to the Wilson River by removing the plug and two tide gates in Blind Slough, removing levee fills at several historic sloughs, and creating an overflow from the left bank of Hall Slough. A swale would be constructed downstream of Highway 101 between Dougherty and Hall sloughs to direct floodwaters into the project area and out to the Bay. The swale would be intended to prevent a rise in 100-year flood elevations upstream of the project area.

Flood elevation modeling completed on the alternative indicated that while the alternative would not result in unacceptable increases in flood levels, it would provide minimal flood reduction benefits (Levesque 2014). Initial model results for this concept showed that for a 100-year flood event, maximum flood elevations just upstream of Highway 101 would be approximately 0.3 feet lower, and the duration of flooding would be approximately 5 hours less.

In addition to the small flood reduction benefits, the grant funding provided to Tillamook County by OWEB, USFWS, and NOAA includes restrictions prohibiting agricultural uses and grazing on lands purchased with the funds (NOAA 2003b). Furthermore, the grants require the properties to be restored to tidal wetlands (Bielski 2014). The USFWS funding was provided through its National Coastal Wetlands Conservation Grant Program. This funding included grant objectives for “protecting, restoring and enhancing the biological resources of the area,” which the USFWS identified as “best met by maximizing the tidal inundation of the acquired properties.” The USFWS specified that alternative uses of the land purchased using its grant funding, such as agriculture or flood storage, would only be permissible if analyses indicated the grant “objectives were unobtainable” (USFWS 2003a).

Because these restrictions on the use of the land preclude the continued agricultural activities, the Modified Wetland Acquisition with Swale Alternative that includes continued agricultural uses was deemed to be infeasible. Because the alternative is not implementable, it was eliminated from further consideration.

3.7.3 River and River Mouth Dredging

During scoping for this EIS, several commenters suggested dredging the rivers and sloughs should be considered as a viable alternative. Multiple potential alternatives involving the dredging of river channels and river mouths to increase floodwater conveyance have been identified and evaluated as a part of previous studies in the project area. Specific projects, including dredging of the Lower Wilson, Trask, and Tillamook Rivers, have been analyzed (USACE 2004a). Dredging alternatives were determined to provide less substantial flood level reduction and more localized benefits when compared to channel widening actions. Channel dredging alternatives also do not provide the ecosystem benefits generated by channel widening or restoration actions (Levesque 2013).

USACE evaluated a number of alternate dredging strategies separately and in combination with other dredging projects. Analysis of dredging of the Lower Wilson River indicated localized flood level reduction in the immediate area of dredging could be up to 1 foot, but the flood reduction benefit dropped to zero change in flood levels upstream at Highway 101 (Levesque 2013).

Their analysis concluded that dredging of the Wilson River from its mouth to the railroad bridge would reduce peak water surface elevations by about 4 inches to 1.3 feet within the modified reach and by about 6 inches at a location just upstream of the railroad bridge during flood conditions similar to the 1999 flood. Dredging the mouth of the Wilson River in addition to the upstream dredging actions potentially would increase flood reduction benefits by about 6 inches.

Dredging in the Lower Trask and Tillamook Rivers was also analyzed for flood risk reduction potential. In the USACE evaluation of the potential benefits associated with dredging the mouth of the Trask and Tillamook Rivers, it found dredging would provide minor reductions in water surface elevations in the modified channels (0.0 to about 10 inches). USACE modelers found that while dredging would increase the capacity within the portion of the channel that was dredged, there was very little effect on widespread flooding during large events (USACE 2004a).

Pearson (2002) reports that clogging of the lower streams and bay by silting is not the primary cause of flooding in the floodplain areas. The effect of high ocean tides driven farther ashore by gale force winds is a far greater cause of flooding. Pearson (2002) concludes that any advantage in getting floodwaters to the ocean as quickly as possible by dredging would depend on the simultaneous occurrence of flooding conditions and the ebb and slack tide. Such an occurrence would be purely coincidental and not dependable. Commonly, the high ocean tides would combine with stream flooding to overflow the deepened channel ways regardless of dredging effort (Pearson 2002).

In addition to the small flood reduction benefits, dredging does not provide ecosystem benefits equivalent to the benefits generated by widening or restoration actions. Despite the shallow waters in the low gradient reaches of the Tillamook estuary, both adult and juvenile salmon can migrate through the rivers. The shallow waters of the rivers and sloughs provide critical juvenile rearing habitat that would be lost if they are dredged.

Specifically dredging for navigation and flood abatement is often cited as a significant detriment to salmon population recovery and associated habitats. Disturbance and introduction of contaminated sediments into the aquatic environment, localized increases in suspended sediments, and removal of food sources are several direct adverse effects to salmon and habitats resulting from dredging (Nightingale and Simenstad 2001). Indirect effects of dredging are detrimental to salmonids and essential habitats and include alteration of flow regimes and water chemistry, such as increasing saltwater intrusion into former freshwater habitats, reductions in shallow rearing habitats, and removal of nutrients from estuarine and riverine habitats (Nightingale and Simenstad 2001; Bottom et al. 2005).

Improvement of juvenile or adult salmon passage as a result of dredging activities is unlikely in any riverine or estuarine system such as that found in Tillamook Bay. Rivers and waterways with low gradients and absent natural (falls, escarpments, dry channels) or manmade (culverts, dams, fish ladders) passage barriers are expected to allow adult and juvenile salmonids to pass through even when shallow water habitats dominate a reach. In addition, any increases in deep-water habitats with the intent of improving adult fish (salmonid) passage would have a detrimental impact on juvenile rearing and foraging areas.

In some situations, there may be a limited beneficial effect from human induced scour events or controlled/simulated flooding in systems with impoundments or restrictions on sediment transport that result in similar effects to channel morphology as dredging. However, these types of actions are undertaken in situations where sediment replenishment or an increase in shallow water habitats is the intended outcome rather than in situations where the improvement of navigation or downstream flows is needed (Nelson et al. 1987). In the Tillamook estuary, the flow regimes and sediment transport have not been artificially altered by impoundments.

Because dredging would not result in measurable flood reduction benefits beyond the dredged area and would result in adverse habitat impacts, these alternatives do not meet the purpose and need and have been eliminated from further consideration.

SECTION 4 Affected Environment and Environmental Consequences

4.1 Introduction

Section 4 describes current conditions and potential impacts on each area of concern that could be affected by the Proposed Action and each alternative. The description of existing conditions serves as a baseline from which potential impacts of the activities are identified and evaluated in each resource area.

For most resources, the methodology included gathering data on the current condition of the resource from existing data sources, developing the thresholds of significance from the relevant regulations and guidance, and evaluating how each alternative would or would not change the existing condition and whether that change would be in compliance with the regulations and guidance. Specific methodologies were used for some resource areas, as described in the respective sections. Techncial memos on some resources are included in the appendices to this EIS to provide additional detail on methods, results of field surveys, and literature reviews.

For each resource, an evaluation of the potential and cumulative impacts of the Proposed Action and alternatives was conducted, distinguishing between construction-related, transition-period, and long-term effects. Where potential impacts were determined to be significant, mitigation measures are identified that would avoid or minimize each impact as much as possible. Impacts described throughout the EIS are direct effects unless otherwise noted. Cumulative effects are described in Section 5. Unavoidable impacts remaining after implementation of BMPs and mitigation measures are described in Section 4.10.

For each area of concern, the magnitude or intensity of potential benefits or adverse impacts were evaluated based on the criteria shown in **Table 4.1-1**.

Table 4.1-1. Impact Magnitude and Context Evaluation Criteria

Impact Scale	Criteria
None/Negligible	The resource area would not be affected, or changes or benefits would be either non-detectable or, if detected, would have effects that would be slight and local. Impacts would be well below regulatory standards, as applicable.
Minor	Changes to the resource would be measurable although the changes would be small and localized. Impacts or benefits would be within or below regulatory standards, as applicable. Mitigation measures would reduce any potential adverse effects.
Moderate	Changes to the resource would be measurable and have either localized or regional scale impacts/benefits. Impacts would be within or below regulatory standards, but historical conditions would be altered on a short-term basis. Mitigation measures would be necessary, and the measures would reduce any potential adverse effects.
Major	Changes would be readily measurable and would have substantial consequences on a local or regional level. Impacts would exceed regulatory standards. Mitigation measures to offset the adverse effects would be required to reduce impacts though long-term changes to the resource would be expected.

Impacts are also described using a local or regional context. Local impacts would occur within the study area or project area as it is defined for each resource area, and regional impacts would occur in the Tillamook Valley or Tillamook Bay unless stated otherwise that they would apply to a larger area.

For each alternative, impacts are discussed by the phase in which they would occur: construction phase, transition phase, and over the long term. Chapter 3 contains construction timelines for each alternative. The transition phase describes an interim period of time following construction when expected long-term changes may still be occurring. Long-term or permanent impacts follow the transition phase and represent the expected outcomes of each alternative. Unless otherwise noted for a particular resource, the construction phase includes the actual construction period or the first 1 to 2 years of proposed project activities; the transition period varies, but is generally 1 to 5 years following construction; and the long-term period follows the transition period out to a planning horizon of approximately 40 to 50 years.

The criteria used for determining the significance of impacts are also described in each section. Significance is based on thresholds described for each resource area. Potential impacts can be significant or less than significant. A potential impact may be less than significant with the implementation of BMPs or other mitigation measures.

4.2 Resources Not Affected and Not Considered Further

This section provides an overview of the resources that would not be affected by the No Action Alternative or any of the action alternatives and that have been removed from further consideration in this EIS.

4.2.1 Wild and Scenic Rivers

The National Wild and Scenic Rivers System (Public Law [P.L.] 90-542; 16 U.S.C. 1271 et seq.) was created in 1968 to preserve rivers with outstanding natural, cultural, and recreational value in a free-flowing condition. The project area is not near any river segment designated as "wild and scenic." There are numerous river segments designated as wild and scenic in the State of Oregon; however, the closest segments to Tillamook County are in the Cascade Mountain Range to the east of the Willamette Valley, more than 100 miles from the project area. The lower 12 miles of the Kilchis River, which flows into Tillamook Bay, is designated as a Recreational River. The Proposed Action and the alternatives would have no effect on the Kilchis River. Therefore, wild and scenic rivers are not considered further in this analysis.

4.2.2 Public Services and Utilities

Public services and utilities include roads, solid waste management, and utility infrastructure, including electrical, water, and sewer lines. Emergency services (e.g., police, hospitals, fire stations) are discussed in Section 4.9.3 Public Health and Safety.

The Tillamook County Comprehensive Plan (1982-2004), Public Facilities section (Goal 11) describes the public services and utilities in the County and sets forth policies to coordinate land use with these public services. Updated information on public services and utilities was obtained from the Tillamook County and City Public Works Departments' websites (Tillamook County 2014b; City of Tillamook 2014).

The Tillamook County Public Works, Solid Waste Department regulates solid waste management while the Roads Department manages emergency transportation routes, identifies road hazards, implements road closures, and maintains mapping capabilities and equipment.

The Tillamook People's Utility District provides electricity to most developed areas of the County. There are several power transmission corridors in the County that connect to several substations, including the City of Tillamook substation and the Port of Tillamook Industrial Park substation within the project area.

The City of Tillamook Public Works Department oversees the City's streets, parks, water and stormwater systems, and wastewater treatment facility. The department maintains the stormwater system and street surfaces and assists with line installations and repair for water and sewer lines. The department also oversees the City's parks, which include Goodspeed Park, Carnahan Park, Coatsville Park, and the Hoquarten Slough Interpretive Trail. The wastewater treatment plant staff oversees operation and maintenance of the City's Class 4 wastewater treatment facility, sewer collection system, and associated lift stations (City of Tillamook 2014).

The City of Tillamook Public Works Department manages the water supply for Tillamook residents and sells surplus water to POTB and 11 rural water districts (City of Tillamook 2014). The City's water supply consists of filtered surface water from Kilam and Fawcett creeks, located southeast of the City, and groundwater from two wells located on the east side of the City. A third well is located near the Highway 101 crossing of the Trask River (City of Tillamook 2014).

Impacts to public services and utilities would be significant if they would increase demand beyond existing capacity or interfere with existing services to such a degree that response times increase, public resources are reduced, or other adverse impacts result.

None of the alternatives would result in an increase in demand for utilities or public services because none of the alternatives would result in new development. None of the alternatives has the potential to adversely affect utility services. Utility infrastructure, including electrical, water, and sewer lines, would be avoided during construction such that no adverse impacts would occur. With the removal of the two residences under Alternatives 1 and 3, some infrastructure would be removed (likely overhead power lines), but the effect would be negligible.

The three action alternatives all have the potential for minor effects on local and state roadways, but the potential increase in traffic would be minor (Section 4.4.2). The potential for wear and tear on roadways to result in the need for additional maintenance is negligible as most construction activity would be located off road for all alternatives.

Alternatives 1 and 3 would generate some solid waste from the demolition of one to two existing residences and the removal of some contaminated soil from the Sadri property. Materials would be recycled or disposed of at an approved permitted landfill, and the quantities produced would not meet or exceed the capacity of existing facilities.

Because there would be no effect on public services or utilities from any of the alternatives, they are not considered further in this EIS.

4.3 Impact Summary

Table 4.3-1 summarizes the conclusions of the EIS regarding the environmental effects of the No Action Alternative and each action alternative.

Impacts considered “moderate” or "major" potentially would be significant impacts. The overall effects of the action alternatives would be beneficial, with few unavoidable adverse impacts.

Many potential effects would not be significant with the implementation of best management practices (BMPs) or mitigation measures. The proposed BMPs and mitigation measures are listed in Section 6 of the EIS. Most of the mitigation measures would apply to all of the alternatives. Because the Hall Slough Alternative would include dredging, additional mitigation measures would be required to reduce the adverse impacts of dredging Hall Slough.

Table 4.3-1. Summary of Potential Effects

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Construction Impacts				
Noise	No effect	Moderate, local, adverse impact from short-term, intermittent noise during construction at one sensitive receptor; impacts would be significant and unavoidable at the sensitive receptor. Transition-period and long-term impacts would be minor, local, adverse, and less than significant.	Moderate, local, adverse impact from short-term, intermittent noise during construction would be less than significant. Minor, local, adverse impact from maintenance dredging would be less than significant. Transition-period and long-term impacts would be minor, local, adverse, and less than significant.	Moderate, local, adverse impact from short-term, intermittent noise during construction at one sensitive receptor; impacts would be significant and unavoidable at the sensitive receptor. Transition-period and long-term impacts would be minor, local, adverse, and less than significant.
Traffic	No effect	Minor, local, adverse impacts from temporary increases in construction-related traffic on Highway 101, Goodspeed Road, and OR 131 would be less than significant. No transition period or long-term effects.	Minor, local, adverse impacts from temporary increases in construction-related traffic on Highway 101 and Wilson River Loop would be less than significant. No transition period or long-term effects.	Minor, local, adverse impacts from temporary increases in construction-related traffic on Highway 101, Goodspeed Road, and OR 131 would be less than significant. No transition period or long-term effects.
Water Resources				
Floodplains	Major, local, adverse short- and long-term impacts on floodplain functions would be significant. Moderate, regional, adverse short- and long-term impacts on floodplain functions would be significant.	Moderate, local, adverse construction-related and transition-period impacts would be less than significant. Moderate, regional, beneficial long-term effect on flood elevations. Major, local, beneficial long-term effect on floodplain functions.	Moderate, local, adverse construction-related and transition-period impacts would be less than significant. Minor, local, beneficial long-term effect on flood elevations. Minor, regional, beneficial long-term effect on floodplain functions.	Moderate, local, adverse construction-related and transition-period impacts would be less than significant. Moderate, regional, beneficial long-term effect on flood elevations. Major, local, beneficial long-term effect on floodplain functions.

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Wetlands	Moderate, local, short-term beneficial effects on wetlands. Major regional, long-term adverse impacts from continued degraded functional conditions would be significant.	Moderate, local, construction-related adverse impacts would be less than significant. Major, local, transition period adverse impacts on freshwater wetlands would not be significant. Major, local and regional, long-term beneficial effects on wetland function and area with the restoration of 522 acres of tidal wetland.	Minor, local, construction-related and transition period adverse impacts would be less than significant. Moderate, local, long-term beneficial effects on wetland function and area with the restoration of 90 acres of riparian flow-through and tidal wetlands between the new setback levees along the Hall Slough channel.	Moderate, local, construction-related adverse impacts would be less than significant. Major, local, transition period adverse impacts on freshwater wetlands would not be significant. Major, local and regional, long-term beneficial effects on wetland function and area with the restoration of 568 acres of tidal wetland.
Hydrology	Major, local, short- and long-term adverse impacts on hydrology from continued flooding would be significant.	Minor, local, adverse construction-related effects on hydrology would be less than significant. Major, regional, short- and long-term beneficial effects on hydrology.	Moderate, local, adverse construction-related effects on hydrology due to dredging would be significant. Minor, local adverse transition period impacts would be less than significant. Minor, regional long-term beneficial effects on hydrology.	Minor, local, adverse construction-related effects on hydrology would be less than significant. Major, regional, short- and long-term beneficial effects on hydrology.
Water Quality	Minor, local, short- and long-term beneficial effects from the passive conversion from agricultural use to freshwater wetlands. Moderate, local, long-term adverse impact from the contaminated materials on the Sadri property would be significant.	Moderate, local, adverse construction-related and transition-period impacts due to turbidity in surface waters could potentially occur; however, with implementation of BMPs and mitigation measures, most impacts would be minor and less than significant. Some unavoidable, adverse, short-term impacts from turbidity and sedimentation would remain during the transition period. Moderate, regional, long-term beneficial effects on water quality.	Moderate, local, adverse impacts due to turbidity in surface waters during construction and periodic maintenance dredging would be less than significant. Moderate, local, transition-period and long-term beneficial effects on water quality due to increased floodplain connectivity, riparian shade, and filtration by wetland vegetation. Moderate, local, long-term adverse impact from the contaminated materials on the Sadri property would be significant.	Moderate, local, adverse construction-related and transition-period impacts due to turbidity in surface waters could potentially occur; however, with implementation of BMPs and mitigation measures, most impacts would be minor and less than significant. Some unavoidable, adverse, short-term impacts from turbidity and sedimentation would remain during the transition period. Moderate, regional, long-term beneficial effects on water quality.

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Groundwater Resources	Minor, local, short- and long-term beneficial effects.	Negligible, local, adverse construction-related impacts would be less than significant. Minor, local, long-term groundwater quality benefits due to discontinued use of two septic systems in project area.	Negligible, local, adverse construction-related impacts would be less than significant. Minor, local, short- and long-term beneficial effects.	Negligible, local, adverse construction-related impacts would be less than significant. Minor, local, long-term groundwater quality benefits due to discontinued use of one septic system in project area.
Biological Resources				
Vegetation	No construction impacts. Minor, local, long-term, beneficial effects from the transition to freshwater wetlands.	Moderate, local, adverse construction-related and short-term impacts from the removal of Sitka spruce trees and loss of riparian vegetation. This impact would not be considered significant because the alternative would transition to the native, historical vegetation condition. Major, local and regional, long-term beneficial effects from the restoration of 522 acres of tidal marsh vegetation.	Minor, local, adverse, construction-related impacts from the removal of riparian vegetation along Hall Slough. Moderate, local, transition period and long-term beneficial effects from the restoration of up to 90 acres of riparian and tidal wetlands and conversion of pasture to freshwater wetlands on County land in the SFC area.	Moderate, local, adverse construction-related and short-term impacts from the removal of Sitka spruce trees and loss of riparian vegetation. This impact would not be considered significant because the alternative would transition to the native, historical vegetation condition. Major, local and regional, long-term beneficial effects from the restoration of 568 acres of tidal marsh vegetation.

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Fish and Wildlife	Moderate, regional, long-term adverse impacts related to continued reductions in floodplain connectivity and potential rearing habitat for anadromous and migratory fish species would be significant. Continued sediment accumulation within channels located inside the diked portion of the study area.	Moderate, local, adverse impacts to terrestrial wildlife and major adverse impacts to aquatic wildlife during construction and in the short term would not be significant with use of BMPs and other mitigation measures. Major, local and regional, long-term, beneficial effects on fish and wildlife would be expected, including beneficial effects from: • Expansion of floodplain connectivity • Increased aquatic cover and habitat complexity for juvenile salmonids, forage fish, juvenile marine fish, and bay residents • Increased use by shorebirds and wading birds and foraging opportunities for migratory and wintering waterfowl • Increased productivity in the Tillamook Bay ecosystem as a whole with the expansion in estuarine habitat, leading to increased fish, bird, and invertebrate abundance and increases in habitat and foraging opportunities	Moderate, local, adverse impacts on fish and wildlife during construction as vegetation becomes re-established would be less than significant. Moderate, local, beneficial effects during the transition period. Moderate, local and regional, long-term beneficial effects to fish and wildlife habitat from the restoration of riverine flow-through wetlands along the banks of Hall Slough. Periodic, minor, local, short-term, adverse impacts from maintenance dredging would not be significant with the use of BMPs.	Moderate, local, adverse impacts to terrestrial wildlife and major adverse impacts to aquatic wildlife during construction and in the short term would not be significant with use of BMPs and other mitigation measures. Major, local and regional, long-term, beneficial effects on fish and wildlife would be expected, including beneficial effects from: • Expansion of floodplain connectivity • Increased aquatic cover and habitat complexity for juvenile salmonids, forage fish, juvenile marine fish, and bay residents • Increased use by shorebirds and wading birds and foraging opportunities for migratory and wintering waterfowl • Increased productivity in the Tillamook Bay ecosystem as a whole with the expansion in estuarine habitat, leading to increased fish, bird, and invertebrate abundance and increases in habitat and foraging opportunities

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Threatened and Endangered Species and Critical Habitat	Moderate, regional, long-term adverse impacts related to the continued degradation of designated critical habitat for coho salmon would be significant. Potential nesting habitat for Marbled murrelet would remain, and trees with suitable structure could improve with age.	Moderate, local, adverse impacts on coho salmon during construction not significant with use of BMPs and mitigation measures. Major, regional, long-term, beneficial effects on coho salmon and critical habitat for coho, including an increase in aquatic habitats, productivity, foraging, and refuge. Moderate adverse impact related to the loss of potential Marbled murrelet nesting trees in both the short and long term; however, a moderate, regional, long-term, beneficial effect from an increase in foraging habitat would result in a net beneficial effect on the species.	Moderate, local, adverse impacts on coho salmon during construction would not be significant with the use of BMPs and mitigation measures. Minor long-term beneficial effects on coho salmon and critical habitat for coho because additional rearing habitat would be created. Periodic, minor, local, short-term, adverse impacts from maintenance dredging would not be significant with the use of BMPs. No effect on Marbled murrelet because there would be no loss of potential nesting trees.	Moderate, local, adverse impacts on coho salmon during construction not significant with use of BMPs and mitigation measures. Major, regional, long-term beneficial effects on coho salmon and critical habitat for coho, including an increase in aquatic habitats, productivity, foraging, and refuge. Moderate adverse impact related to the loss of potential Marbled murrelet nesting trees in both the short and long term; however, a moderate, regional, long-term, beneficial effect from an increase in foraging habitat would result in a net beneficial effect on the species.
Physical Resources				
Geology and Soils – Seismic	No effect	No change from existing conditions.	No change from existing conditions.	No change from existing conditions.
Geology and Soils – Fluvial Geomorphology	Moderate, regional, adverse, long-term impacts on fluvial geomorphology from continued disruption of natural fluvial processes would be less than significant.	Major, local, adverse impacts during construction and in the short term from soil erosion could potentially occur; however, with implementation of BMPs and mitigation measures, impacts would be moderate and less than significant. Minor, local, long-term adverse impacts would be less than significant, with some beneficial aspects of more natural channel formation.	Major, local, adverse impacts during construction and in the short term from soil erosion could potentially occur; however, with implementation of BMPs and mitigation measures, impacts would be moderate and less than significant. Minor, local, long-term adverse impacts would be less than significant, with some beneficial aspects of more natural channel formation.	Major, local, adverse impacts during construction and in the short term from soil erosion could potentially occur; however, with implementation of BMPs and mitigation measures, impacts would be moderate and less than significant. Minor, local, long-term adverse impacts would be less than significant, with some beneficial aspects of more natural channel formation.

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Geology and Soils – Farmland Protection	No effect	Minor, local, adverse long-term impact from the indirect conversion of 353 acres (320 acres currently farmed) of farmland of statewide importance to wetlands would be less than significant.	Minor, local, adverse long-term impact from the indirect conversion of 86 acres of farmland of statewide importance would be less than significant.	Minor, local, adverse long-term impact from the indirect conversion of 393 acres (260 acres currently farmed) of farmland of statewide importance to wetlands would be less than significant.
Coastal Resources	No adverse effects related to compliance with the Coastal Zone Management Act (CZMA). Moderate, regional, long-term significant impact from not meeting the goals of the County Comprehensive Plan or the state planning goals.	No adverse effects related to compliance with CZMA. Major, regional, long-term beneficial effects from restoration of tidal marsh ecosystem.	No adverse effects related to compliance with CZMA. Moderate, regional, long-term beneficial effects from restoration of riparian and tidal wetlands along Hall Slough.	No adverse effects related to compliance with CZMA. Major, regional, long-term beneficial effects from restoration of tidal marsh ecosystem.
Air Quality	No effect	Minor, local, adverse impacts during construction would be less than significant. No transition period or long-term impacts.	Minor, local, adverse impacts during construction would be less than significant. No transition period or long-term impacts.	Minor, local, adverse impacts during construction would be less than significant. No transition period or long-term impacts.

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Climate Change	No impacts on climate change. Minor, local, adverse short-term impacts from climate change would be less than significant. Potential moderate to major, regional, long-term adverse effects from climate change could be significant.	Minor, regional, adverse impact of project construction on climate change would be less than significant. Moderate, regional, transition period and long-term beneficial effects on climate change from the restored floodplain, which may help the community to adapt to sea level rise that would occur from climate change. Minor, regional, short- and long-term beneficial effects against impacts from climate change.	Minor, regional, adverse impact of project construction on climate change would be less than significant. Moderate, regional, transition period and long-term beneficial effects on climate change from restored Hall Slough channel, which may help the community to adapt to sea level rise that would occur from climate change. Minor, regional, short- and long-term beneficial effects against impacts from climate change.	Minor, regional, adverse impact of project construction on climate change would be less than significant. Moderate, regional, transition period and long-term beneficial effects on climate change from the restored floodplain, which may help the community to adapt to sea level rise that would occur from climate change. Minor, regional, short- and long-term beneficial effects against impacts from climate change.
Hazardous Materials	Moderate, local, long-term adverse impact from the potential for release of contaminants from the Sadri property would be significant.	Moderate, local, adverse impacts during construction at the Sadri property could potentially occur; however, impacts would be minor and less than significant after implementation of BMPs and mitigation measures. Minor, local, transition period and long-term adverse impacts from the potential for release of hazardous materials from heavy equipment used for maintenance activities would be less than significant.	Minor, local, adverse impacts during construction, transition period, and long term from the potential for release of hazardous materials from heavy equipment used for construction and maintenance activities would be less than significant.	Moderate, local, adverse impacts during construction at the Sadri property could potentially occur; however, impacts would be minor and less than significant after implementation of BMPs and mitigation measures. Minor, local, transition period and long-term adverse impacts from the potential for release of hazardous materials from heavy equipment used for maintenance activities would be less than significant.
Visual Quality and Aesthetics	Generally no effect. Major flooding has potential to result in major, local, adverse short-term impacts that would be significant.	Moderate to major, local, adverse construction and transition-period impacts would be significant. Minor to moderate, local, adverse long-term impact related to tree removal would be less than significant.	Moderate to major, local, adverse construction and transition-period impacts would be significant. Minor to moderate, local, adverse long-term impact related to tree removal would be less than significant.	Moderate to major, local, adverse construction and transition-period impacts would be significant. Minor to moderate, local, adverse long-term impact related to tree removal would be less than significant.

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Cultural Resources				
Cultural Resources	No effect	Minor, local, adverse impacts due to a low potential to encounter cultural resources during construction; with implementation of mitigation measures, impacts would be less than significant. No transition period or long-term impacts.	Minor, local, adverse impacts due to a low potential to encounter cultural resources during construction; with implementation of mitigation measures, impacts would be less than significant. No transition period or long-term impacts.	Minor, local, adverse impacts due to a low potential to encounter cultural resources during construction; with implementation of mitigation measures, impacts would be less than significant. No transition period or long-term impacts.
Socioeconomics				
Economics	Generally no effect; however, flooding has potential for major, regional, adverse long-term economic impacts that would be significant.	Minor to moderate, regional, temporary beneficial effects to the economy during construction. Moderate to major, regional, transition-period and long-term beneficial effects from the reduced potential for flooding, including reduced flood impacts on adjacent farmlands. Major, regional, long-term benefit to coastal fisheries. Negligible, regional, long-term adverse impact related to conversion of farmland would be less than significant.	Minor to moderate, regional, temporary beneficial effects to the economy during construction. Minor, regional, transition-period and long-term beneficial effects from the reduced potential for flooding. Negligible, regional, long-term adverse impact related to conversion of farmland would be less than significant.	Minor to moderate regional temporary beneficial effects to the economy during construction. Moderate to major regional, transition-period and long-term beneficial effects from the reduced potential for flooding, including reduced flood impacts on adjacent farmlands. Major regional long-term benefit to coastal fisheries. Negligible regional long-term adverse impact related to conversion of farmland would be less than significant.
Environmental Justice	Generally no effect; however, flooding has potential for major, local, adverse impacts.	No adverse impacts during construction. Major, regional, long-term beneficial effects related to reduced flooding.	No adverse impacts during construction. Moderate, regional, long-term beneficial effects related to reduced flooding.	No adverse impacts during construction. Major, regional, long-term beneficial effects related to reduced flooding.

Resource Category	No Action Alternative	Proposed Action Alternative 1	Hall Slough Alternative Alternative 2	SFC – Initial Alternative Alternative 3
Public Health and Safety	Major, local, adverse impacts related to continued potential for disruption of public services and increased demand for public safety services during floods would be significant.	Major, local, adverse construction-period impacts to safety could occur; however, with implementation of mitigation measures, impacts would be minor and less than significant. No effect on emergency services. Long-term, local, beneficial effects from reduced flooding risk and decrease in manure application. Minor, local, long-term impacts from increased mosquitos although more study is needed to verify; this would be less than significant.	No effect on emergency services. Major, local, adverse construction-period impacts to safety would be significant; with implementation of mitigation measures, impacts would be minor and less than significant. Long-term beneficial effects from reduced flooding risk.	Major, local, adverse construction-period impacts to safety could occur; however, with implementation of mitigation measures, impacts would be minor and less than significant. No effect on emergency services. Long-term, local, beneficial effects from reduced flooding risk and decrease in manure application. Minor, local, long-term impacts from increased mosquitos although more study is needed to verify; this would be less than significant.
Recreation	Moderate, local, adverse impacts on populations of recreational fish and shellfish would be significant. Minor, local, beneficial effect from the limited recreational access.	Minor, local, adverse impacts related to closure of recreational areas during construction would be less than significant. Minor, local, adverse impacts on fishing during construction would be less than significant. Moderate to major short- and long-term beneficial effects on recreational fish and shellfish populations.	Minor, local, adverse impacts related to closure of recreational areas during construction would be less than significant. Minor, local, adverse impacts on fishing during construction would be less than significant. Moderate short- and long-term beneficial effects on recreational fish and shellfish populations.	Minor, local, adverse impacts related to closure of recreational areas during construction would be less than significant. Minor, local, adverse impacts on fishing during construction would be less than significant. Moderate to major short- and long-term beneficial effects on recreational fish and shellfish populations.

4.4 Construction Impacts

Some resources, such as noise and traffic, only have construction-related impacts and are discussed as subsections in this section. The construction-related impacts associated with other resource areas, such as water, biological, cultural, and socioeconomic, are discussed in the subsections on those topics along with their transition and long-term effects.

4.4.1 Noise

Sounds that disrupt normal activities or otherwise diminish the quality of the environment are considered noise. Noise events that occur during the night (10:00 p.m. to 7:00 a.m.) are more disturbing than those that occur during normal waking hours (7:00 a.m. to 10:00 p.m.). Some wildlife species (for example, Marbled murrelet) are more sensitive to noise at night (USFWS 2015c). Potential effects of noise on wildlife are discussed in Section 4.6.2 and Section 4.6.3. The potential effects of noise are related to distance from the source, background levels, and the randomness of a noise. Assessment of noise impacts includes the proximity of the proposed action to sensitive receptors. A sensitive receptor is defined as an area of frequent human use that would benefit from a lowered noise level. Typical waking hour sensitive receptors include schools, churches, hospitals, and libraries.

Audible noise is usually measured in decibels (db) on the A-weighted scale (dBA), which models sound as it corresponds to human perception. The human ear perceives sound, which is mechanical energy, as pressure on the ear. Generally, a change of 1 dBA is not detectible by the human ear, while a change of 3 dBA is noticeable to most people.

The State of Oregon has established statewide noise thresholds for industrial and commercial noise sources (Oregon Administrative Rules [OAR], Chapter 340, Division 35). While noise from construction activities is exempt from the standards in this policy, the policy does establish regulatory thresholds for commercial and industrial activities that can be used as significance thresholds.

The City of Tillamook's Code of Ordinances includes a Noise Ordinance that prohibits the generation of "any noise which disturbs, injures or endangers the health, safety or welfare of others." The ordinance further defines noise as a sound that:

> (1) Is capable of being heard at or beyond the boundary of property from which the noise originates;
>
> (2) Results in a disturbance of the peace;
>
> (3) Exceeds sound in volume made by any make and model of engine or machine that is not consistent with its new or stock, manufactured condition; and/or
>
> (4) Can be heard inside a noise sensitive unit.

The section identifies "the construction, including excavation, demolition, alteration or repair of a building or other structure, or repair of a vehicle or other machinery other than between the hours of 7:00 a.m. and 6:00 p.m. except upon special permit granted by the City" as a violation of the ordinance. While most of the study area is outside of the City limits, these descriptions may also be used as thresholds of significance for the proposed alternatives.

4.4.1.1 Affected Environment

Noise events in and near the study area are presently associated with climatic conditions (wind, rain), transportation noise (traffic on roads), agricultural activities (heavy equipment), industrial activities (large trucks, forklifts, back up alarms), and "life sounds" (people talking, children playing). Areas adjacent to the study area contain the Tillamook Regional Medical Center and a number of residences and businesses.

The project area includes large areas of pasture, hay fields, and scattered residences that would have minimal or intermittent noise levels associated with dairy cows, farm equipment, and life sounds. Average ambient noise levels associated with the agricultural and rural residential land uses of the study area are generally very low. The predominant sources of noise are agricultural equipment and vehicular traffic. However, the study area also includes a portion of the Highway 101 business district and an area of industrial uses in the City along Front Street, which fronts a portion of the study area. Where the study area crosses Highway 101, there would be a higher existing noise level than most of the study area. In particular, vehicles traveling along Highway 101 generate noise in the study area.

Ambient daytime noise levels in low-density rural areas, such as those in the project area, range from 35 to 45 dBA (EPA 1978). Noise levels close to the highway could reach 70 to 80 dBA on a regular basis. Noise levels on Highway 101 in the study area would not be as high as reported noise levels for other highway systems because the highway is within the City of Tillamook at that location and posted speed limits are reduced, which reduce noise impacts.

Within the project area, vegetation, terrain, and the elevation of the receiver relative to the sound source may all reduce the perception of noise. Breaking the line of sight between the receiver and the sound source, such as with a levee, can result in a sound level reduction of approximately 5 dBA.

4.4.1.2 Environmental Consequences

Noise impacts from construction equipment in the project area and construction-related traffic on sensitive receptors in the study area were evaluated for each project alternative. There would be no long-term impacts related to noise for any alternative, given that no new long term noise sources would be developed. Potential impacts are described consistent with the impact evaluation criteria presented in **Table 4.1-1** such that moderate and major impacts would be considered significant. This analysis relies on the thresholds outlined in the Oregon Noise Control Regulations for Industry and Commerce that prohibit new noise sources that raise ambient noise levels by more than 10 dBA as measured at the property boundary of the nearest noise sensitive property to identify moderate and major impacts. While construction noise is exempt from this regulation, the 10 dBA limit is being utilized in this EIS to identify significant impacts. Because ambient noise levels in the quieter parts of the study area range from 35 to 45 dBA, any noise increase at the property boundary of a sensitive receptor in the study area that would exceed 55 dBA would be a significant impact.

The analysis in this section relies on known maximum noise levels as measured 50 feet from the source for construction equipment planned for use on site. Known noise values for typical construction equipment are presented in **Table 4.4-1** (Federal Transit Administration 2006). This analysis relies on the combined equipment value of 89 dBA[2] to capture the maximum noise level that could be expected 50 feet from the construction zone.

Table 4.4-1. Typical Construction Noise Levels

Type of Equipment	Maximum Noise Level (dBA) at 50 Feet
Backhoe	80
Bulldozer	85
Chainsaw	85
Concrete pump	82
Crane	85
Heavy truck	88
Pneumatic tools	85
Road grader	85
Combined equipment	89

Source: Federal Transit Administration 2006

The intensity of noise from a point source like construction equipment is reduced as the distance of the point source from the receptor increases. Standard noise reduction estimates for this reduction in intensity for construction sources assume a 6 dBA reduction in noise level per doubling of distance from the source (Washington State Department of Transportation [WSDOT] 2015). **Table 4.4-2** presents calculated noise attenuation levels for combined construction point source noise based on the distance from the source.

Table 4.4-2. Attenuation of Construction Noise with Distance

Distance from Source (feet)	Point Source (-6dBA)
50	89
100	83
200	77
400	71
800	65
1,600	59
3,200	53
6,400	47

Source: Washington State Department of Transportation 2015

[2] *Construction noise point source decibel levels from equipment that is operated at the same time is combined utilizing a logarithmic scale as opposed to being combined arithmetically. In the case of the construction equipment presented in Table 4.4-1, the combined equipment decibel level is calculated utilizing the following formula: Combined dBA = 10 x* $\log_{10}(\sum_1^n 10^{Ln/10})$.

In addition to attenuation by distance, noise levels are also reduced by topography and vegetation. Specific reductions include an estimated 5 dBA reduction when topography breaks the line of sight from the source when compared to unobstructed noise levels at the same distance. Vegetation also reduces noise levels, with dense vegetation reducing noise levels by 5 dBA for every 100 feet of vegetation that separates the source from the receptor (WSDOT 2015).

4.4.1.2.1 No Action Alternative

Construction/Transition/Long Term

Under the No Action Alternative, there would be no construction and no impacts related to noise during any time period. Over the long term, as agricultural uses are phased out on the County-owned lands, the occasional minor noise from agricultural equipment would also be phased out.

4.4.1.2.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Construction

Construction of any of the action alternatives would involve the use of heavy equipment, which may generate noise that is out of character for the rural setting of the study area.

This analysis assumes noise generated during construction of Alternative 1 could occur at any one time anywhere in the project area, and as a result, the distance between the project area boundary and the property boundary of the nearest identified sensitive receptors was measured to determine whether during construction a noise level of 55 dBA could be exceeded at that sensitive receptor.

During construction of the Proposed Action, noise from construction equipment and vehicles would be localized, intermittent, and temporary. All construction activities would be limited to normal working hours during the daytime, defined as 7:00 a.m. to 6:00 p.m. in City of Tillamook Code of Ordinances (Title XIII, Section 130.08). The Proposed Action construction sequence assumes the work could be completed with one 10-hour shift per day, which would occur during the daytime hours, 7 days per week.

In the final stages of the project when the work has to be timed around the high tides, shifts likely would be shorter but still limited to daytime hours, given the inherent complications of working in darkness in an area with limited to no utility services. This later phase that would need to work around the tides likely would occur in September and October; therefore, it is unlikely “daytime” work would occur beyond the City of Tillamook’s definition of 6:00 p.m. In any case, this final phase of work, which would involve the removal of the perimeter levee, would all be located around the western end of the project area. The closest receptors to this work would be several residences along Bayocean Road directly across the Trask River and approximately 750 feet from the proposed work.

The Tillamook Regional Medical Center parking lot abuts the project area boundary. As a result, it is assumed noise levels of up to 89 dBA could be measured at the medical center property boundary; however, the medical center buildings would be 350 to 450 feet from the closest noise sources. Vegetation in the project area would be expected to attenuate some construction noise, but it would not be able to block all noise generated by work in that part of the project area. Although work in most of the project area would be too far from the medical center to result in an impact, there would be a short-term, intermittent, moderate noise impact when construction equipment is in operation close to the property boundary.

Noise from truck traffic and increased worker trips would contribute temporarily to existing traffic noise on local roads (see Section 4.4.2), including Highway 101; however, there would be no discernable change in average traffic noise levels because there would be only a minor increase in traffic.

Overall, moderate, local, short-term and intermittent adverse noise impacts would occur during construction of the Proposed Action. These impacts would be significant and unavoidable when noise exceeds 55 dBA at sensitive receptors such as the medical center.

Transition Period and Long Term

Occasional maintenance activities would be intermittent and short term and would be located along the levees retained and constructed under the Proposed Action. Impacts would be minor, local, and less than significant. Activities along most of the levee length typically would involve invasive weed control using equipment such as light duty trucks, mowing equipment, and hand tools. This equipment would not generate noise levels greater than typical agricultural equipment. Occasional tide gate replacement, as described in Section 3, would require heavier and louder equipment; however, the proposed tide gates and flood control structures are located far enough away from the Tillamook Regional Medical Center that there would not be any effect on this sensitive receptor.

4.4.1.2.3 Alternative 2: Hall Slough Alternative

Construction

The noise intensity generated by construction of Alternative 2 would be the same as the Proposed Action; the maximum noise level at any one time anywhere in the project area specific to the Hall Slough Alternative could reach 89 dBA. Although total area impacted by this noise level would be smaller, the project area is generally closer to a larger number of residences and businesses. Most of the businesses along the Highway 101 corridor would not be considered sensitive receptors, and construction during daytime hours would not be expected to have more than a minor effect in these areas. The Tillamook Regional Medical Center is approximately 4,000 feet to the south, and the distance is obstructed by the large forested area on both sides of Hoquarten Slough. Given this distance, noise generated by construction activities would not be anticipated to exceed 55 dBA at the medical center.

The Hall Slough Alternative project area is in close proximity to existing residences, which would be subject to moderate noise impacts if residents are home during construction hours. There are several residences very close to the area where new setback levees would be constructed west of Highway 101 and also at the upper end of Hall Slough where it would be reconnected to the Wilson River. Potential noise impacts from dredging equipment would be expected to result in minor impacts both during the initial dredging and during maintenance dredging because the equipment would be shielded from adjacent residences by the levees. Noise impacts from dredging would be less than significant.

While short term and intermittent, noise during construction for the Hall Slough Alternative would have a moderate adverse impact on nearby residences; however, this impact would not be considered significant because it would occur in conformance with local noise ordinances, occur during the day, and would not impact sensitive receptors.

Transition Period and Long Term

Maintenance activities would be short term and intermittent and would be located along the levees retained and constructed under the alternative. Impacts would be minor, local, and less than significant. Activities would be similar to those described under the Proposed Action and would also be similar to those that currently occur along the existing levees. Since the new setback levees are relatively close to the position of the existing levees, there would be no difference in the effect of maintenance activities on adjacent properties. There also would be no effect on the medical center, which is considered a sensitive receptor.

4.4.1.2.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction

The project area for Alternative 3 is similar to the project area for the Proposed Action, and the same types of construction equipment would be utilized, resulting in noise impacts that may differ slightly in schedule and total duration but would be identical in terms of intensity when measured at the nearest sensitive receptor. The proposed work in the southeastern portion of the project area near the Tillamook Regional Medical Center would be the same as under the Proposed Action. Therefore, adverse noise impacts from construction of Alternative 3 would be moderate, local, short term, and intermittent, but significant and unavoidable when noise exceeds 55 dBA at sensitive receptors such as the medical center.

Transition Period and Long Term

Maintenance activities would be short term and intermittent and would be located along the levees retained and constructed under the alternative. Impacts would be minor, local, and less than significant. Activities would be similar to those described under the Proposed Action and would also be similar to those that currently occur along existing levees. Occasional tide gate replacement would require heavier and louder equipment; however, the proposed tide gates and flood control structures are located far enough away from the Tillamook Regional Medical Center that there would not be any effect on this sensitive receptor.

4.4.2 Traffic

This section describes the primary roadways that construction truck and worker traffic would use and provides an evaluation of the potential traffic effects to these roadways.

4.4.2.1 Methodology

The evaluation for each alternative was based on construction data, including potential number of construction trucks, construction truck routes and timing, construction staging area locations, number of workers, and worker traffic routes and timing. Existing and forecasted traffic flow levels on state roads and highways were collected from the Oregon Department of Transportation (ODOT). Potential effects were compared to adopted federal, state, and local traffic plans to evaluate significance.

4.4.2.2 Affected Environment

The primary roadways that construction truck and worker traffic would use are:

- U.S. Highway 101 (Highway 101)
- Goodspeed Road

- Oregon Highway 131 (OR 131) and local roadways north of OR 131 in central Tillamook
- Wilson River Loop

The following sections describe the current conditions for these roadways.

4.4.2.2.1 Highway 101

Highway 101 in Oregon begins at the Oregon/Washington state line and ends at the Oregon/California state line. Highway 101 is also referred to as the Oregon Coast Highway and is approximately 365 miles in length. Highway 101 is owned and maintained by ODOT.

The Oregon Highway Plan (OHP), ODOT's long-range highway plan, designates Highway 101 as a "Statewide Highway" and part of the National Highway System (NHS). According to the OHP, Statewide Highways on the National Highway System provide inter-urban and inter-regional mobility and connections to larger urban areas, ports, and major recreation areas that are not directly served by Interstate Highways. A secondary function of Statewide Highways on the NHS is to provide connections for intra-urban and intra-regional trips. The management objective of Statewide Highways is to provide safe and efficient, high-speed, and continuous-flow operation. Highway 101 is also designated as National Scenic Byway by the U.S. Department of Transportation.

Highway 101 at Goodspeed Road (milepost 64.74) is within City of Tillamook limits. Highway 101 has four 12-foot travel lanes (two travel lanes in each direction), a 14-foot wide center-turn lane, and two 5-foot shoulders, for a total width of 72 feet.

Annual average daily traffic (AADT) volumes in the vicinity of Goodspeed Road were obtained from ODOT traffic volume data for the most recent 5 calendar years of available data (**Table 4.4-3**). Since 2009, the AADT on Highway 101 has increased slightly. The 5-year AADT in the study area ranged between 10,320 north of City of Tillamook limits to 18,460 north of Hadley Road (near Hoquarten Slough immediately north of downtown Tillamook).

Table 4.4-3. Highway 101 AADT in Vicinity of the SFC Project

Location	Milepost	2009	2010	2011	2012	2013	5-Year Average
North of Alderbrook Loop Road	63.14	10,000	10,000	9,500	11,000	11,100	10,320
South of Alderbrook Road	63.22	11,500	11,400	10,900	12,500	12,600	11,780
Wilson River Bridge	64.23	12,900	12,800	12,200	13,300	13,400	12,920
South of Wilson River Loop	64.59	16,000	15,900	15,100	17,700	17,900	16,520
North of Blue Heron Drive	65.04	17,700	17,600	16,700	19,200	19,300	18,100
North of Hadley Road	65.23	18,000	17,900	17,100	19,600	19,700	18,460

Source: Oregon Department of Transportation 2014
Note: Goodspeed Road is between Wilson River Loop and Blue Heron Drive (milepost 64.74).

An automatic traffic recorder (ATR) site on Highway 101, approximately 11 miles north of Goodspeed Road, at milepost 53.55, provides more detailed Highway 101 traffic data. An analysis of 2013 traffic data from the ATR site demonstrates that traffic volumes increase by approximately 49 percent over the average daily traffic (ADT). **Table 4.4-4** demonstrates the variability in traffic volumes by month at the ATR.

Table 4.4-4. Highway 101 ADT Variability by Month (Milepost 53.55)

Month	ADT	Percent of ADT
January	4,094	70
February	4,541	77
March	5,381	92
April	5,396	92
May	6,012	102
June	6,676	114
July	8,769	149
August	8,674	148
September	7,123	121
October	5,500	94
November	4,300	73
December	4,013	68
Average	4,094	100

Source: Oregon Department of Transportation 2014

ODOT developed state highway mobility targets for the OHP as a method to gage reasonable and consistent standards for traffic flow along state highways. These mobility targets consider the classification and location of each state highway and are based on volume-to-capacity (v/c) ratios. A v/c ratio is a ratio of traffic flow rate to capacity of the road to handle that traffic flow. A v/c ratio at or over 1.0 indicates the road or intersection is over-capacity; a v/c ratio under 1.0 indicates additional vehicles can be accommodated.

As part of ODOT's alternatives analysis for the Highway 101/OR 6 project in downtown Tillamook between 2010 and 2012, ODOT determined all signalized intersections on the Highway 101 couplet (between 1st Street and 4th Street) met their applicable OHP mobility targets (0.95 for signalized intersections) during the peak hour of operations. Because traffic volumes have not substantially increased since that analysis in 2010, and because all intersections operated well below the 0.95 target in 2010, it is assumed these intersections still meet their applicable OHP mobility targets today.

4.4.2.2.2 Goodspeed Road

Goodspeed Road begins at Highway 101 (milepost 64.74) within Tillamook City limits at a stop-controlled intersection and ends approximately 1.9 miles to the west in rural unincorporated Tillamook County. Only the easternmost approximately 500 feet of Goodspeed Road is within Tillamook City limits. The City of Tillamook Transportation System Plan (TSP) designates Goodspeed Road as a "collector" (Angelo Eaton 2003). The function of a collector roadway is to collect traffic from local streets and provide connections to arterial roadways. Goodspeed Road provides access to rural residential land uses west of Highway 101. Tillamook County owns and maintains the entire length of the roadway. The road is paved but is unstriped and can accommodate two-way travel at low speeds. It crosses Hall Slough by bridge. There are no recorded traffic volumes available for this roadway.

4.4.2.2.3 OR 131

OR 131, referred to as the Netarts Highway, begins at Highway 101 southbound (Main Avenue) in downtown Tillamook and ends to the west in Oceanside. It is approximately 9 miles in length. OR 131 is owned and maintained by ODOT.

The OHP classifies OR 131 as a "district highway." According to the OHP, District Highways are facilities of County-wide significance and function largely as County and City arterials or collectors. They provide connections and links between small urbanized areas, rural centers, and urban hubs and also serve local access and traffic. The management objective of District Highways is to provide for safe and efficient, moderate to high-speed, continuous-flow operation in rural areas reflecting the surrounding environment and moderate to low-speed operation in urban and urbanizing areas for traffic flow and for pedestrian and bicycle movements.

OR 131 within Tillamook City limits (milepost 8.41 to 9.08) is two travel lanes (one lane in each direction) with a total roadway surface width ranging between 36 and 43 feet. There is no median or center-turn lane.

AADT volumes on OR 131 within Tillamook City limits were obtained from ODOT for the most recent 5 calendar years of available data (**Table 4.4-5**). Since 2009, the AADT on OR 131 has remained approximately the same. The 5-year AADT average ranges between 4,760 at the west City limits of Tillamook to 5,780 west of Stillwater Avenue.

Front Street, Cedar Avenue, and Birch Avenue are designated "collectors" and truck routes within Tillamook City limits (Angelo Eaton 2003; CH2M Hilland Jeanne Lawson & Associates 2006). Trucks are encouraged to use these collectors to reduce truck traffic on Highway 101 between Front Street and OR 131 and on OR 131 between Highway 101 and Birch Avenue. Travel lanes on these collectors are narrow, and parking impedes truck movements.

Table 4.4-5. OR 131 AADT in Vicinity of Project (2009-2013)

Location	Milepost	2009	2010	2011	2012	2013	5-year Average
West City limits of Tillamook	8.56	4,800	4,800	4,600	4,800	4,800	4,760
0.02 mile west of Cedar Avenue	8.70	5,200	5,200	4,900	5,500	5,500	5,260
0.02 mile west of Elm Avenue	8.81	5,400	5,300	5,100	5,400	5,400	5,320
0.02 mile west of Stillwater Avenue	8.96	5,700	5,700	5,400	6,000	6,100	5,780
0.02 mile west of Highway 101 southbound	9.06	5,000	5,000	4,800	5,300	5,400	5,100

Source: Oregon Department of Transportation 2014

4.4.2.2.4 Wilson River Loop

Wilson River Loop begins at Highway 101 (milepost 64.59) within Tillamook City limits at a signal-controlled intersection and ends approximately 3.25 miles to the southeast at Oregon Highway 6 in rural unincorporated Tillamook County. The first 500 feet at the western end is under City jurisdiction and is maintained by the City. The balance of the road is under County jurisdiction and maintenance. Wilson River Loop is designated as a "collector" in the City of Tillamook TSP and provides access to rural areas northeast of Tillamook. The roadway is paved with two travel lanes. The posted speed is 45 miles per hour. Tillamook County owns and maintains the entire roadway. The Tillamook TSP identified that in 2002 the intersection operated at a level of service of B and a v/c of 0.60; therefore, it had sufficient capacity to accommodate more traffic growth.

4.4.2.3 Environmental Consequences

The approximate average daily construction traffic estimates generated by each action alternative throughout the construction period, including construction traffic type, are shown in **Table 4.4-6**. Potential effects were compared to adopted federal, state, and local traffic plans to evaluate significance.

Table 4.4-6. Approximate Average Daily Construction Trips

Construction Traffic Type	Vehicle Trips		
	Alternative 1 (Proposed Action)	Alternative 2 (Hall Slough Alt.)	Alternative 3 (Initial Alternative)
Average number of construction truck trips to/from site [1]	52	16	51
Construction worker vehicle trips to/from site [2]	32	32	32
Average number of cross-site construction truck trips [3]	5	0	5
Miscellaneous construction truck trips to/from site [4]	10	10	10
Total Approximate Average Daily Construction Trips	**99**	**58**	**98**

Notes:

*1 – Average number of truck trips per construction day based on the quantity of imported and exported imported materials provided in **Tables 3-3, 3-6, and 3-8**. Assumes 1 cubic yard weighs 1.65 tons and a 10 cubic yard truck carries 16.5 tons. Also assumes 22 construction work days per month over 5 months (May to September) to provide a conservative estimate because lower construction trip traffic is anticipated in October 2016.*

*2 – The number of construction workers would vary by month based on the details provided in **Tables 3-3, 3-6, and 3-8**. Assumes the month with the highest number of construction workers and each worker would generate two trips each construction day.*

3 – The average number of cross-site truck trips; that is, trips utilizing public streets to move soil material cuts and fills within the project site, assumes potential movement of 2,000 to 6,000 cubic yards of material on Highway 101 for Alternatives 1 and 3 and none for Alternative 2. Each truck load involves two trips on public streets.

4 – General assumption based on anticipated construction activities. Includes delivery and removal of construction equipment (i.e., mobilization/demobilization).

4.4.2.3.1 No Action Alternative

Under the No Action Alternative, no construction would occur; therefore, there would be no traffic impacts. There also would be no transition period or long-term impacts under the No Action Alternative.

4.4.2.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Construction

Construction would generate traffic to varying degrees on Highway 101, Goodspeed Road, OR 131, local roadways north of OR 131 in central Tillamook, and Wilson River Loop during the construction period. Potential effects on each of these roads are discussed below with estimates presented for all of the action alternatives. Findings of potential effects are then summarized following the discussion for each roadway.

The route used by construction trucks to import and export materials and construction equipment would be determined by the contractors selected to construct the selected alternative. Because this information would be determined in the future, the following provides a conservative analysis of potential traffic impacts to the primary roadways anticipated to be directly impacted from construction-related traffic during the construction period.

Highway 101

During construction, Highway 101 would carry street-legal construction truck and worker traffic for all action alternatives, but general use of Highway 101 would not be limited during construction. Traffic increases on Highway 101 would result from activities to deliver and remove off-road equipment, import and export materials, and provide construction worker access during the construction period. Under Alternatives 1 and 3, Highway 101 traffic would increase as soil materials may be hauled from the northwest construction site to the southern portion of the site to balance material cuts and fills. Use of Highway 101 for cut/fill balancing would avoid the need to construct a temporary trestle or pontoon bridge to haul materials across Hoquarten Slough.

The use of Highway 101 by construction-related vehicles would have a short-term direct effect on highway travelers from potential brief and infrequent traffic delays. The increase in construction-related traffic on Highway 101 would represent a slight increase in daily traffic volumes compared to its existing use. This low and temporary increase is not expected to adversely degrade traffic operations or safety because the construction-related trips would be spread throughout the workday.

Table 4.4-7 and **Table 4.4-8** provide high-level quantitative assessments of potential traffic impacts to Highway 101 during the construction period.

Table 4.4-7. Estimated Highway 101 Construction Period Traffic Change North of Goodspeed Road

Highway 101 AADT (2013) – North of Goodspeed Road	Approximately 17,900 vehicles
Approximate Traffic Volume During Construction Activity Hours (7:00 a.m. to 5:00 p.m.)	Approximately 14,320 vehicles
Approximate Increase in Daily Traffic from Construction Activities (see **Table 4.4-6**)	Alternative 1: ~94 vehicles Alternative 2: ~58 vehicles Alternative 3: ~93 vehicles
Approximate Increase in Daily Traffic from Construction Activities	Alternative 1: ~0.6% Alternative 2: ~0.4% Alternative 3: ~0.6%

Table 4.4-8. Estimated Highway 101 Construction Period Traffic Change South of Goodspeed Road

Highway 101 AADT Volume (2013) – South of Goodspeed Road	Approximately 19,300 vehicles
Approximate Traffic Volume During Construction Activity Hours (7:00 a.m. to 5:00 p.m.)	Approximately 15,440 vehicles
Approximate Increase in Daily Traffic from Construction Activities (see **Table 4.4-6**)	Alternative 1: ~94 vehicles Alternative 2: ~58 vehicles Alternative 3: ~93 vehicles
Approximate Increase in Daily Traffic from Construction Activities	Alternative 1: ~0.6% Alternative 2: ~0.4% Alternative 3: ~0.6%

Goodspeed Road

Goodspeed Road would carry much of the construction truck and worker traffic as the primary access point to the project site for all action alternatives. During construction, traffic would increase on Goodspeed Road to deliver and remove construction equipment, import and export materials, and provide construction worker access during the construction period. General use of Goodspeed Road would not be limited during construction.

The increased use of Goodspeed Road by construction-related vehicles would increase traffic on Goodspeed Road, have a short-term direct effect to travelers, and would represent an increase in daily traffic volumes compared to the road's existing use. This low and temporary increase would not adversely degrade traffic operations or safety because the construction-related trips would be spread throughout the workday.

Table 4.4-6 illustrates the approximate average daily construction traffic generated by the action alternatives during the construction period.

OR 131

Construction vehicle access could be provided from central Tillamook via OR 131 and local roadways north of OR 131 (such as Cedar Avenue and Birch Avenue) to portions of the project area for Alternatives 1 and 3. Therefore, OR 131 and local roadways north of OR 131 would experience an increase in traffic during the construction period. The Sadri parcel most likely would be accessed from OR 131. The number of daily construction trips generated would vary by alternative throughout the primary construction period (May to October 2016).

Construction-related traffic on OR 131 would access the project site via local roadways north of OR 131. The potential increased use of OR 131 and local roadways north of OR 131 in central Tillamook by construction-related vehicles would increase traffic on these roadways and have a short-term direct effect on local traffic and would represent an increase in daily traffic volumes compared to the roadways' existing use. This low and temporary increase is not expected to adversely degrade traffic operations or safety because the construction-related trips would be spread throughout the workday.

Table 4.4-9 provides a high-level quantitative assessment of potential traffic impacts to OR 131 during the construction period.

Table 4.4-9. Estimated Increases in OR 131 Traffic during Construction Period

OR 131 AADT Volume – West of Cedar Avenue	Approximately 5,500 vehicles
Approximate Traffic Volume During Construction Activity Hours	Approximately 4,400 vehicles
Approximate Increase in Daily Traffic from Construction Activities	Alternative 1: ~99 vehicles Alternative 2: No change Alternative 3: ~96 vehicles
Approximate Increase in Daily Traffic from Construction Activities	Alternative 1: ~2.2% Alternative 2: No change Alternative 3: ~2.2%

Transition Period and Long Term

After the construction period, there would be no effects on travel times, traffic safety, public transit service, or physical condition of existing roadways under the Proposed Action.

Summary of Effects

As illustrated in **Table 4.4-7** and **Table 4.4-8**, AADT of Highway 101 was approximately 17,900 vehicles north of Goodspeed Road and 19,300 south of Goodspeed Road in 2013. Assuming that approximately 80 percent of the traffic volumes occur between 7:00 a.m. and 5:00 p.m., Highway 101 AADT in 2016 is similar to 2013 AADT, and that all traffic travels in one direction, the Proposed Action would increase traffic on Highway 101 by approximately 0.6 percent near Goodspeed Road. The actual percent increase from construction activities could be lower north and south of Goodspeed Road because construction-related traffic could come from both directions on Highway 101.

Additional construction-related traffic would be added to the section of Highway 101 between Goodspeed Road and Front Street (south of Hoquarten Slough) for the movement of materials between the northwestern and southeastern portions of the site. An additional five trips per day, on average, would be added to Highway 101 for these cross-site movements of materials. If a temporary trestle or pontoon bridge is constructed for internal movement of material, these additional trips would not occur on Highway 101.

To minimize potential traffic effects on Highway 101 during construction, traffic control signs would be posted on Highway 101 to alert motorists of trucks turning onto and from Highway 101. The construction schedule also would be posted in local newspapers and websites. Flaggers may be used at uncontrolled intersections during truck ingress and egress. Therefore, the alternative would not create traffic mobility concerns on Highway 101 in downtown Tillamook.

Increased construction traffic on public streets could cause additional wear and tear of the highway facility, especially at points of entering and exiting. There could be a need for roadway repair or maintenance during or at the completion of the construction period.

For the Proposed Action, all construction traffic to the northwest portion of the site would use Goodspeed Road, assuming one construction vehicle access point. If alternate construction vehicle access is provided from central Tillamook via OR 131 and local roadways, the construction-related traffic that would use Goodspeed Road would be lower than the estimates provided in **Table 4.4-6**. For example, some traffic would access the southeastern portion of the site from routes other than Goodspeed Road. Also, if a temporary bridge over Hoquarten Slough was constructed, traffic would be able to access the northwest portion of the site without using Goodspeed Road.

AADT on OR 131 was approximately 5,500 vehicles west of Cedar Avenue in 2013. Assuming (1) 80 percent of the AADT volumes occur between 7:00 a.m. and 5:00 p.m., (2) OR 131 AADT in 2016 will be similar to the AADT in 2013, and (3) all traffic travels in one direction, the Proposed Action would increase the traffic on OR 131 by approximately 2.2 percent near Cedar Avenue. The actual percent increase in daily traffic from construction activities could be lower because construction-related traffic could be coming from both directions on OR 131.

To minimize potential transportation effects on OR 131 during construction, traffic control signs would be posted on OR 131 to alert motorists of trucks. Also, the construction schedule would be posted in local newspapers and websites so the traveling public could take evasive actions.

There is potential for vehicle conflicts on Front Street, Cedar Avenue, and Birch Avenue in light of their designations as collectors and truck routes. Construction traffic would increase to access property south of Hoquarten Slough and for the cross-site movement of materials in lieu of an internal temporary bridge over Hoquarten Slough. However, the increase in construction traffic on these collectors would be minimal, on average, and short term. During limited periods of high truck congestion, through truck traffic could be directed away from these collectors (along Highway 101 and OR 131), and street parking could be temporarily restricted to improve mobility.

The Proposed Action would not require upgrades or expansion of the capacity of any of the roadways. The low and temporary increase in construction-related traffic would not be expected to adversely degrade traffic operations or safety because the construction-related trips would be spread throughout the workday. Therefore, potential impacts to travel times, traffic safety, and public transit service would be low, and the Proposed Action would have a minor traffic impact during the construction period (May through October 2016).

Minor traffic impacts during construction of the Proposed Action would be less than significant because traffic increases would be small and localized and would not interfere with the primary functions of state and federal highways or local connectors. There would be no transition period or long-term impacts.

4.4.2.3.3 Alternative 2: Hall Slough Alternative

Construction

Public streets would carry construction truck and worker traffic under the Hall Slough Alternative. As shown in **Table 4.4-6**, the approximate average daily construction traffic generated by Alternative 2 would be less than that under the Proposed Action. Wilson River Loop would provide access for the construction activities east of Highway 101 for Alternative 2. Therefore, the average daily construction trips during the construction period would be even lower than the estimates provided in **Table 4.4-6**. As shown in **Table 4.4-7** and **Table 4.4-8**, potential traffic impacts to Highway 101 would be less under Alternative 2 than for the Proposed Action.

The Hall Slough Alternative is the only alternative that would need to use the Wilson River Loop during construction. General use of and access to Wilson River Loop would not be limited during the construction period. The increased use of Wilson River Loop by construction-related vehicles would increase traffic on the roadway, have a short-term direct effect to travelers, and represent an increase in daily traffic volumes compared to the road's existing use. This low and temporary increase would not adversely degrade traffic operations or safety because the construction-related trips would be spread throughout the workday.

Therefore, potential impacts to travel times, traffic safety, and public transit service would be low, and the Hall Slough Alternative would have a minor traffic impact during the construction period. Similar BMPs to those described under the Proposed Action would be used as needed (e.g., the use of traffic flaggers, signage, and construction schedule notices).

Transition Period and Long Term

After the construction period, there would be no effects on travel times, traffic safety, public transit service, or physical condition of existing roadways under the Proposed Action.

Summary of Effects

Minor traffic impacts during construction of the Hall Slough Alternative would be less than significant because traffic increases would be small and localized and would not interfere with the primary functions of state and federal highways or local connectors. Compared to the Proposed Action, the Hall Slough Alternative would have fewer effects on traffic during construction. As with the Proposed Action, the Hall Slough Alternative would not have long-term impacts on traffic in the project area.

4.4.2.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction

Public streets would carry construction truck and worker traffic under Alternative 3. Construction-related traffic would follow similar routes as described under the Proposed Action. Therefore, Alternative 3 would have similar effects on traffic during construction.

As shown in **Table 4.4-6,** the approximate average daily construction traffic generated by Alternative 3 would be very similar to that under the Proposed Action. As with the Proposed Action, most construction traffic would use Goodspeed Road if there is one construction vehicle access point to the project site. If alternate construction vehicle access is provided from central Tillamook via OR 131 and local roadways, the construction-related traffic that would use Goodspeed Road would be lower than the estimates provided in **Table 4.4-6**. Because some construction traffic would access the Sadri parcel from OR 131, construction-related traffic would be less than shown in **Table 4.4-6**.

Potential traffic impacts on Highway 101 under Alternative 3 would be similar to those described for the Proposed Action. As with the Proposed Action, additional construction-related traffic would be added to the section of Highway 101 between Goodspeed Road and Front/3rd streets (south of Hoquarten Slough) for the movement of materials between the southeastern and northwestern portions of the project site. An additional five trips per day, on average, would be added to Highway 101 and Front/3rd streets for these cross-site movements of materials. If a temporary trestle or pontoon bridge is constructed for internal movement of material, then these additional trips would not occur on Highway 101.

As with the Proposed Action, alternate construction vehicle access could be provided from central Tillamook via OR 131 and local roadways north of OR 131 (such as Cedar Avenue and

Birch Avenue). The alternative would not create traffic mobility concerns on Highway 101 in downtown Tillamook. Also, potential traffic impacts to OR 131 during the construction period would be similar to those described for the Proposed Action.

As with the Proposed Action, construction traffic on Front Street, Cedar Avenue, and Birch Avenue would be minimal, on average, and short term. During limited periods of high truck congestion, through truck traffic could be directed away from these collectors (along Highway 101 and OR 131), and street parking could be temporarily restricted to improve mobility.

Increased construction traffic on public streets could cause additional wear and tear of the highway facility, especially at points of entering and exiting. There could be a need for roadway repair or maintenance during or at the completion of the construction period.

Potential impacts to travel times, traffic safety, and public transit service would be low, and Alternative 3 would have a minor traffic impact during the construction period. Similar BMPs to those described under the Proposed Action would be used as needed (e.g., the use of traffic flaggers, signage, and construction schedule notices). After the construction period, there would be no effects on travel times, traffic safety, public transit service, or physical condition of existing roadways under the SFC – Initial Alternative.

Summary of Effects

Minor traffic impacts during construction of Alternative 3 would be less than significant because traffic increases would be small and localized and would not interfere with the primary functions of state and federal highways or local connectors. Alternative 3 would have similar effects on traffic during construction. As with the Proposed Action, Alternative 3 would not have long-term impacts on traffic in the study area.

4.5 Water Resources

This section provides an overview of water resources in the study area, including floodplains, wetlands, hydrology, water quality, and groundwater. The effects analysis considers the potential for each of the project alternatives to have effects related to flooding, wetlands hydrology, water quality, and groundwater levels. The evaluation of effects related to flooding and hydrology was based primarily on information from modeling studies. The evaluation of the project alternatives considers temporary construction effects as well as long-term effects on water resources.

Water resources within the study area are regulated by several federal, state, and local laws and policies, which are described in detail in Appendix C and summarized here.

Federal laws include the Clean Water Act (particularly Sections 401, 402, and 404), the Rivers and Harbors Act, Safe Drinking Water Act, National Flood Insurance Act and Flood Disaster Protection Act, Executive Order 11988 on Floodplain Management, Executive Order 11990 on the Protection of Wetlands, Sole Source Aquifers protection under 40 CFR 149, as well as FEMA regulations contained in 44 CFR.

At the state level, water resources are protected by ODEQ Water Quality Certification, ODEQ National Pollutant Discharge Elimination System (NPDES) Stormwater Discharge Permit 1200-C, Water Pollution Control Act, Oregon Removal-Fill Law, and the Oregon State-Wide Planning Goals and Guidelines.

Locally, the Tillamook County Comprehensive Plan and the City of Tillamook Flood Mitigation Action Plan guide water resources decisions.

4.5.1 Floodplains

Executive Order (EO) 11988, Floodplain Management, requires federal agencies to take actions to minimize occupancy of and modifications to floodplains. FEMA regulations in 44 CFR 9, Floodplain Management and Protection of Wetlands, set forth the policy, procedures, and responsibilities to implement and enforce EO 11988 and prohibit FEMA from funding improvements in the 100-year floodplain unless no practicable alternative is available.

To satisfy the requirements of EO 11988, the Water Resources Council developed an eight-step process that agencies should carry out as part of their decision making on projects that have potential impacts to or within a floodplain or a wetland. The eight steps reflect the decision-making process required in Section 2(a) of the EO and are reflected in FEMA regulations at 44 CFR 9.6. The first step is to determine if the Proposed Action is in the base floodplain or a wetland. The Proposed Action would be located within a floodplain and within wetlands. The combined floodplain/wetland eight-step process is documented in Appendix D and is summarized in Section 4.5.1.3.2.

4.5.1.1 Methodology

To determine potential impacts on floodplains, the floodplain maps were reviewed, and existing literature on the study area was collected and evaluated to develop the description of the affected environment. A general field reconnaissance was conducted to further evaluate existing conditions in the study area. The potential impacts of each alternative on floodplain functions and values were evaluated and are described in the environmental consequences section. Flooding in the study area has been extensively studied and modeled. A review of the modeling efforts and hydrology in the study area is described in Section 4.5.3.

4.5.1.2 Affected Environment

Floodplains provide many important benefits, including flood storage, control of erosion and water quality, and support of biological resources, such as fisheries, and they are often important areas for agriculture and recreation.

Floodplain Setting

As described in Section 1.1, five major rivers enter Tillamook Bay, which includes the mouths of the Miami, Kilchis, Wilson, Trask, and Tillamook rivers (**Figure 1-1**). The Wilson, Trask, and Tillamook rivers pass through the Tillamook Valley to Tillamook Bay, creating a large floodplain vulnerable to severe flooding. The City of Tillamook lies along a ridge that separates the Wilson and Trask rivers; just downstream of the City is Tillamook Bay. The Wilson and Trask rivers are the two largest rivers that flow into Tillamook Bay, and they produce the largest floods.

A number of narrow channels provide confined pathways for riverine flows to enter the estuary from upland sources and for tidal flows to enter and leave the estuary from the ocean. During times of heavy upland precipitation and runoff, the hydraulic conditions within the backbay area of the estuary (southern and eastern portions of Tillamook Bay) become dominated by riverine flow.

FEMA flood insurance rate maps (FIRMs) show floodplain areas and illustrate the extent of the 100-year floodplain within the SFC project area. **Figure 4.5-1** depicts the proposed SFC work areas and extent of the floodplain within the study area. Within the Alternative 1 project area, approximately 7.6 acres are within Zone X (shaded) (moderate flood hazard areas), 1.05 acres are within Zone X500 (minimal flood hazard areas), and 656.9 acres are within Zone A (areas subject to flooding during a 100-year flood). The Alternative 2 project area, to the east of the Alternative 1 project area, is also primarily located within Zone A, with a smaller portion in Zone X. Alternative 3 is similar to Alternative 1. **Table 4.5-1** lists the FIRMs for the study area. Newer FIRMs have been developed but not yet adopted. There is a possibility they may be adopted prior to project completion.

Table 4.5-1. Flood Insurance Rate Maps for the Study Area

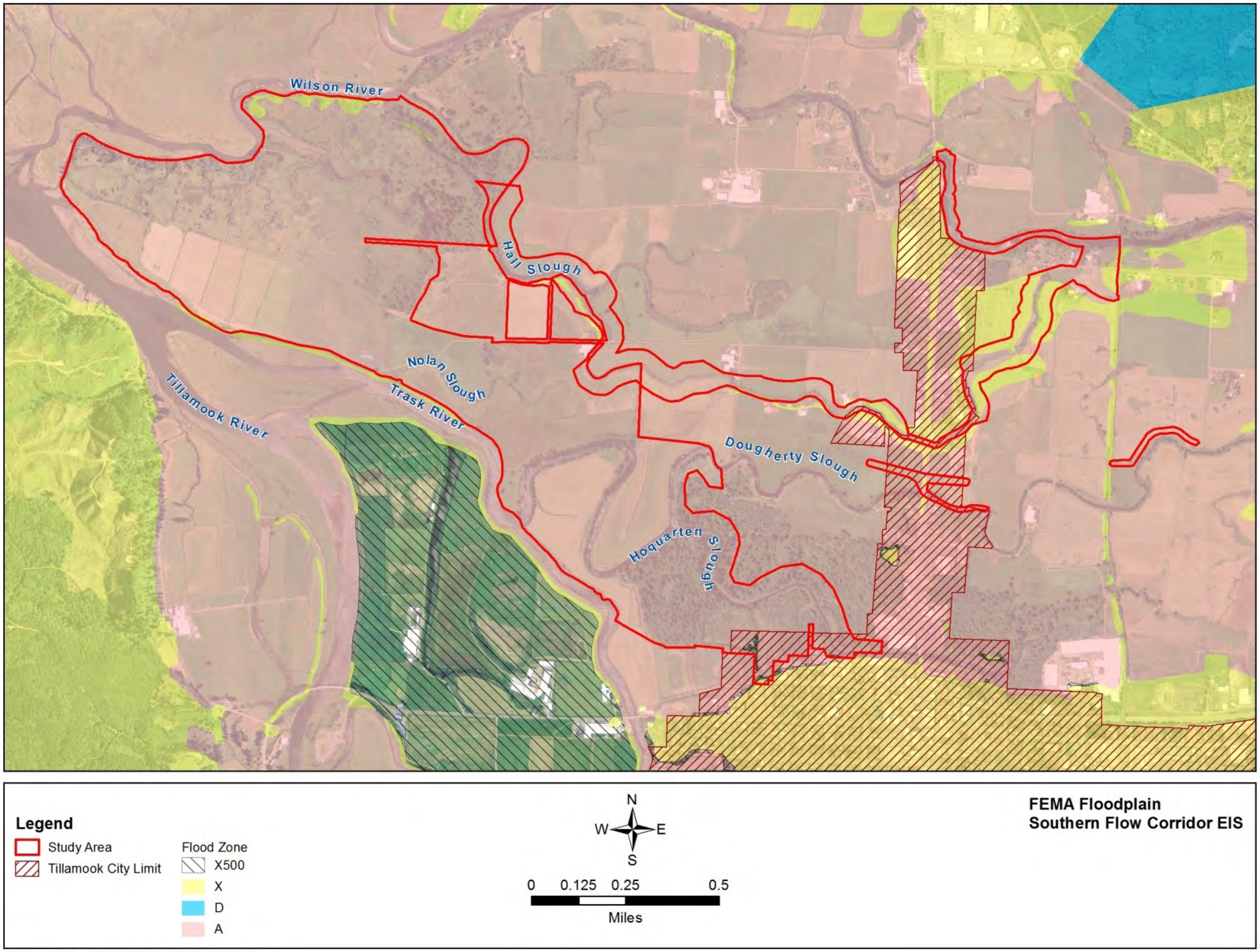
Panel Number	Effective Date
4101960155B	September 30, 1983
4101960160C	August 30, 2002
4101960165A	August 1, 1978
4101960170C	August 30, 2002
4102020001E	April 16, 2004
4102020002E	April 16, 2004
4102020003E	April 16, 2004
4102020004E	April 16, 2004

The current level of flood protection for the majority of land, buildings, and infrastructure in the valley, including the Highway 101 corridor, depends on an assemblage of privately built and maintained levees of varying quality. Flood levels along the river do not differ greatly under different flows; the difference between a 5-year and 100-year flood is less than 1 foot for much of the reach, so floodwaters overtop the south bank of the Wilson River at relatively shallow depths regardless of flood magnitude. As these overbank flows join and flow west through the Southern Flow Corridor, the difference in depth becomes greater. On Highway 101 at Hoquarten Slough, the difference in flood elevation between a 5-year and 100-year flood is almost 3 feet.

History of Floodplain Management in Tillamook

The Tillamook area was originally settled for agricultural purposes from the 1850s through the late 1800s. Logging became a local industry around 1880. The Wilson, Trask, and Tillamook rivers were used for log drives between the 1880s and 1910. The log drives damaged river banks and created obstructions to boat use in the rivers. By 1900, the lowland areas were cleared of trees and developed into farmlands. The majority of farms in the valley historically have been dairy farms (Coulton et al. 1996), and dairy farms are still the predominant agricultural pursuit.

In the early 1900s, dikes and levees began to be built to reduce flooding. The first drainage districts were formed in the early 1900s, and the majority of the land currently used for farming had been cleared and drained by the late 1920s. Dikes along the Wilson, Trask, and Tillamook floodplains were primarily constructed to prevent pasture flooding from tidal overflows (Coulton et al. 1996). Historical accounts of flooding along roadways in the Tillamook area date back to 1919. This understanding that the valley is likely to flood minimized initial development in floodplain areas.



Data Sources: CDM Smith, Tillamook County, NHC, USDA NAIP 2012

Figure 4.5-1. Floodplains in the SFC Study Area

The major forest fires that occurred through the 1930s, 1940s, and 1950s affected the infiltration and water storage capacity of mountainous upland areas in the upper watershed. The loss of flood attenuation mechanisms, in conjunction with steep upland slopes, increased the frequency and amount of runoff as well as sediment delivery during large rain events. To protect properties and structures in the lowlands, the river and slough channels were dredged, woody debris was removed, and levees and dikes were constructed. These controls satisfied short-term needs for maintaining and growing the local commerce and economy but did so with long-term costs to the landscape and biological resources (Coulton et al. 1996).

The levee systems cut off the floodplain from the riverine flood-driven inputs of sediment and nutrients and also cut off the lower floodplains from tidal fluctuations from the bay. This loss of floodplain connectivity in the valley has impacted fisheries' resources. The conversion of large areas from forested lowlands to agricultural areas has impacted wildlife resources.

The disconnection of the floodplain from the river channels has degraded the aquatic habitats in the rivers. Water quality is affected by increased turbidity and contaminants in runoff from adjacent farms and urban areas that are mobilized during flood events. Many aquatic species have adapted to move into slower moving waters that spread out over the floodplain during a flood to escape areas of fast moving water. When the floodplain is disconnected through dikes and levees, these species are not able to find the low velocity refuges they need to survive a flood.

Flood Hazards

The rivers in the Tillamook Valley are perched above their floodplains. In many locations, the floodplains are lower than the rivers and connected to the river system through a network of sloughs. The floodplains were diked (through natural and anthropogenic means) along the rivers and sloughs to limit tidal inundation and allow the floodplains to be used for agricultural purposes. Levees separate the rivers and sloughs from their floodplains; therefore, when floodwater overtops the banks of the Wilson, Trask, and Tillamook rivers, it is trapped in the floodplains behind the natural and constructed levees. The flood reduction benefits from the levees in the study area extend beyond the properties on which they are built. Conversely, these structures can also cause increases in flood levels that extend well beyond their immediate location. Having a large breach in a levee would increase floodplain flows and flood levels. For example, a large breach in a levee may result in flood levels typically expected for a 10-year flood occurring during a 5-year flood.

As a result of these levees, the study area contains a system of disconnected channels that create increased flood problems, including standing water when floods recede and increased flood stages within channels. Manmade features, such as levees and roads, along with land development have caused flooding in areas that did not historically flood. Based on a review of the November 1999 flood, it was shown the lower rivers do not have the capacity to carry floodwaters, and they depend largely on the floodplain to carry floodwaters to Tillamook Bay (USACE 2005).

The Wilson River regularly reaches flood stage (approximately 14,100 cfs). Between 1973 and 2005, it exceeded flood stage approximately 60 times, averaging almost two floods per year in the recent past (USACE 2005). Heavy rains in the mountains to the east cause the rivers within the study area to rise quickly, and when combined with high tides, the Tillamook area floods.

The City and County of Tillamook repeatedly experience severe floods, and in recent years, the community has implemented several flood mitigation projects to reduce damage from future floods. The City center largely remains flood free; however, newly developed areas to the north and south of the main downtown area experience flooding almost annually. The worst flooding occurs north of downtown along the Highway 101 business area. This relatively recently developed area lies in the direct path of floodwaters from the Wilson River. Floodwaters come from all sides in this area, from the Wilson and Trask rivers and from high tides and storm surges from the Bay. **Figure 4.5-2** shows floodwater depths predicted for a 100-year flood event under existing conditions (i.e., modeled without the SFC project). See Appendix K for predicted water depths during other flood recurrence events.

The Highway 101 corridor between Hoquarten and Dougherty sloughs is in the lowest area of the floodplain. Flood flows currently overtop the south bank of the Wilson River upstream and flow down and over the highway at considerable depths at this location. In addition, the land is currently at elevations only 1 to 2 feet above wintertime high tides and is open to tidal influence via the sloughs that bound the area.

The farmlands west of Highway 101 depend on the levee system to protect them from tides. Much of the land has subsided and now lies below mean high tide elevations. Interior drainage in the Tillamook region is provided by hundreds of tide-gated culverts throughout the lower river system.

Although many levees have been built around the area, only the Stillwell levee actually protects a large tract of land near the mouth of the Trask and Tillamook rivers from flooding (**Figure 4.5-3**). This levee forces water to flow around it through the Trask and Tillamook river channels. As a result, floodwater regularly overtops the Trask and Tillamook river banks upstream of the Stillwell levee and floods the area between the Trask and Tillamook rivers.

Hall Slough is a side channel of the Wilson River. The slough's origins are upstream of Highway 101 near the Wilson River Loop Road, and its downstream end comes back into the Wilson River about 3 miles downstream (near the mouth of the Wilson River). Hall Slough was connected to the Wilson River at its upstream end before 1950. At that time, a bridge was in place that crossed Hall Slough on the Wilson River Loop Road. Since then, the slough has been filled at its upstream end, the bridge removed, and a small culvert placed through the Wilson River Loop Road to drain the area behind it. Floodwaters from the Wilson River flow over the left bank of the river near the historic Hall Slough entrance and then flow down the Wilson River Loop Road to Highway 101 where they flow south along the highway and eventually cross and flood the highway. These nuisance floods occur every year or two.

4.5.1.3 Environmental Consequences

Based upon the regulatory framework established by the regulations discussed in Section 4.5.1, and using the impact scale described in **Table 4.1-1**, each alternative was qualitatively evaluated to identify potential impacts on floodplains. For the purpose of this EIS, an impact would be significantly adverse if it would negatively affect floodplain functions or increase flood damages in or near the project area.

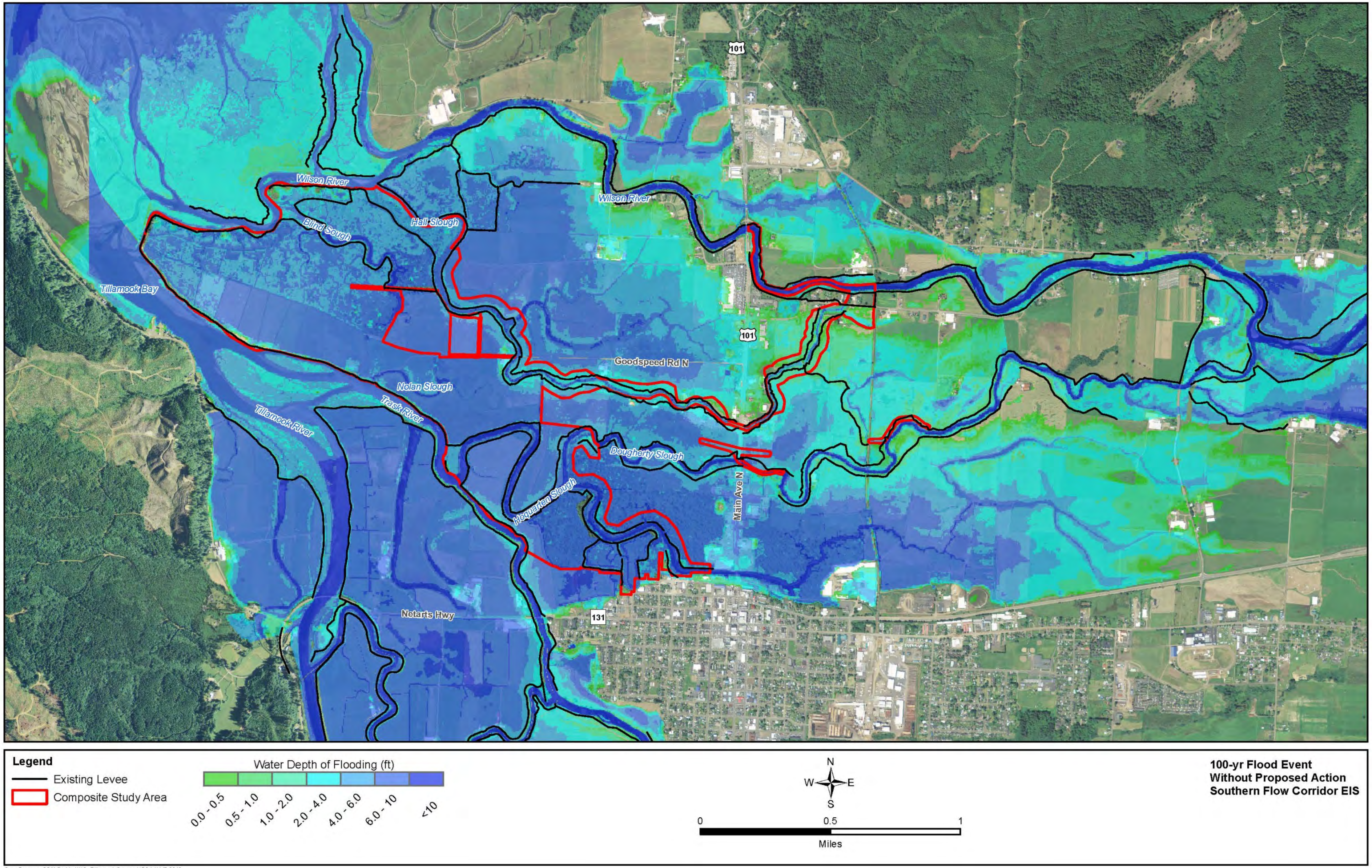


Figure 4.5-2. Modeled Water Depths During a 100-year Flood Event

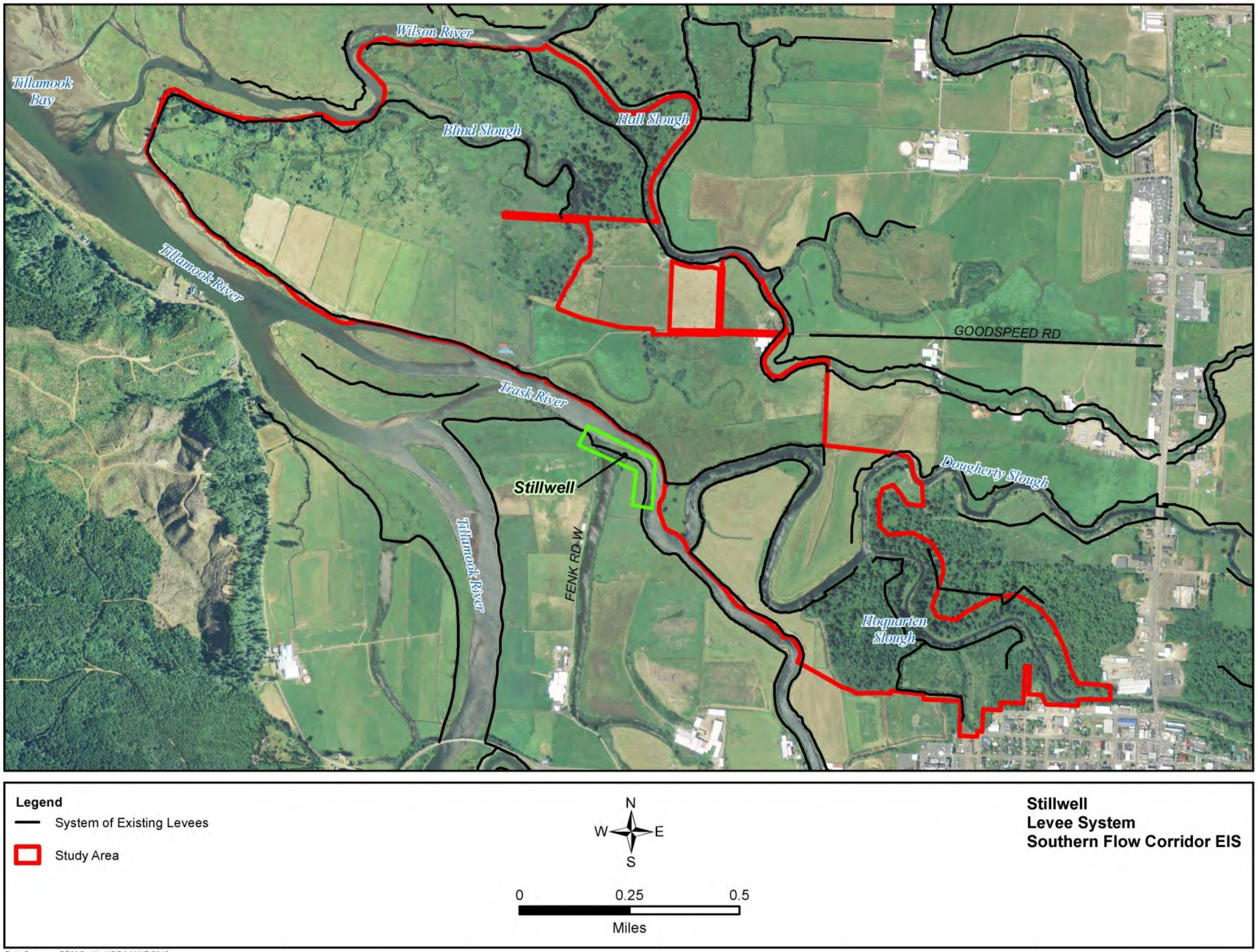


Figure 4.5-3. Location of the Stillwell Levee

4.5.1.3.1 No Action Alternative

The No Action Alternative represents no change in existing floodplain conditions; the flooding probability and inundation areas would be similar to current conditions.

Construction

There would be no construction activities as part of the No Action Alternative; therefore, there would be no construction-related impacts on floodplains.

Transition and Long Term

Flooding conditions would not improve under the No Action Alternative, and flood damage is expected to worsen due to increased economic use of flood-prone areas and trends in flood processes. Floodplain connectivity and natural beneficial functions would continue to be in a degraded condition over the long term under the No Action Alternative. The land previously purchased by the County likely would revert to freshwater wetlands but would not realize the benefits of reconnection with tidal regimes.

Under the No Action Alternative, flood flows would continue to overtop the south bank of the Wilson River and flow down and over Highway 101 between Hoquarten and Dougherty sloughs at considerable depths. In addition, the land is now at elevations only 1 to 2 feet above wintertime high tides and is open to tidal influence via the sloughs that bound it. Projected sea level rise would result in wintertime high tides and storm surges that may inundate the highway corridor itself.

The farmlands west of Highway 101 depend on the levee system to protect them from tides. Much of the land has subsided and now lies below mean high tide elevations. Projected sea level rise would result in higher flood levels in the project area, assuming no changes to the existing levee system. Some of the lands along Highway 101 north of Hall Slough are also at low elevations and would be at risk from sea level rise. Impacts of sea level rise on the hazardous materials at the Sadri property (see Section 4.7.5) would be negligible because the existing levees would limit tidewaters from affecting the area. However, because the contamination would not be cleaned up, there would continue to be a risk of large floods eroding the material and spreading it across the floodplain. To address sea level rise, the community might increase levee heights along Hall Slough; however, raising levee heights could also increase flooding along Highway 101.

Although the current agricultural uses in the SFC project area would be phased out over time and the area would be expected to revert to freshwater wetlands, it would remain disconnected from the river channels, and natural floodplain functions would not be restored over the long-term analysis horizon of 40 to 50 years. The No Action Alternative would not improve the natural and beneficial functions of the floodplain, which can be one way to address potential impacts from sea level rise and flooding.

Therefore, impacts could occur under the No Action Alternative with a potential increase in flood damages in or near the project area. Locally, the short- and long-term impacts of the No Action Alternative on floodplains would be major, adverse, and significant. Regionally, the short- and long-term impacts of the No Action Alternative on floodplains would be moderate, adverse, and significant. The No Action Alternative would not meet the purpose and need for reducing flood damages and restoring habitat functions.

4.5.1.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Eight-Step Decision-Making Process Summary

The Proposed Action would be located within a floodplain and within wetlands. In compliance with EO 11988 and EO 11990, the combined floodplain/wetland eight-step process is documented in Appendix D and summarized here. The detailed analysis of potential effects on floodplains under the Proposed Action follows this summary, and the analysis of potential effects on wetlands is in Section 4.5.2. The eight-step process also addresses the proposed consolidation of contaminated materials in the southeast corner of the project area (see Section 3.4.1.7).

- **Step 1 - Determine if the Proposed Action is located in the base floodplain and/or wetland.** The Southern Flow Corridor – Landowner Preferred Alternative would take place within the base floodplain and wetland.

- **Step 2 - Provide early public notice.** Preliminary public notice of the proposed project was provided with the NOI published in the *Federal Register* on May 6, 2014.

- **Step 3 - Identify and evaluate alternatives to locating in the base floodplain and/or wetlands.** Alternatives to the Proposed Action are discussed in Sections 4.5.1 and 4.5.2. Alternatives to consolidating contaminated materials on City property in the southeast corner of the project are detailed in the eight-step process in Appendix D as well. Alternatives that would relocate the Proposed Action outside of the floodplain and wetlands would not meet the project purpose and need and would not be a practicable alternative.

- **Step 4 - Identify impacts of Proposed Action associated with occupancy or modification of the floodplain and/or wetland.** Impacts of the Proposed Action, including the proposed consolidation of contaminated soils from the Sadri property, on floodplains and wetlands are discussed in Sections 4.5.1 and 4.5.2 and detailed in Appendix D.

- **Step 5 - Design or modify the Proposed Action to minimize threats to life and property and preserve its natural and beneficial floodplain values.** Engineering design of the Proposed Action was modified based on recommendations from a geotechnical analysis (Shannon & Wilson, Inc. 2014). Modifications to the original design include setting back the levees further from the channels, installation of toe drains, and additional monitoring using piezometers. Overall, the Proposed Action would be beneficial to floodplain and wetland functions and values.

- **Step 6 - Determine if the Proposed Action is practicable and reevaluate alternatives.** Based on additional analysis, the Proposed Action is determined to be practicable. This EIS presents an evaluation of alternatives.

- **Step 7 - Provide findings and public explanation.** Public notice of the availability of this Draft EIS will be provided, and there will be a minimum 30-day public comment period for review of the alternatives analysis and findings. Public comment will be incorporated into the EIS. Following the publication of the Final EIS, another public notice of availability will be published, and there will be a 30-day period for review of the findings.

- **Step 8 - Implement the action.** FEMA will publish a decision on whether to provide grant funding in a ROD before implementation would be able to proceed. POTB would implement the action in accordance with the decision in the ROD and all applicable requirements.

Construction

Under Alternative 1, 1.4 miles of new setback levees would be constructed within the floodplain, and 2.8 miles of levees would be modified. Construction of Alternative 1 is expected to occur between May and October 2016 when it is drier and floods are less likely to occur. Follow-up work during the summer of 2017 would be focused on the new setback levees and tide gate structures and would not have more than minor, local effects on floodplains. Given the magnitude of construction, impacts would be moderate, local, adverse, and significant.

During construction of Alternative 1, construction materials likely would be transported along Highway 101 between the areas north and south of Hoquarten Slough; however, a temporary trestle or pontoon bridge across the slough may be used instead. This trestle or bridge would impact local flood levels if a flood were to occur during construction. Because the trestle bridge would be temporary, only used for a short time, and removed at the end of construction in October, it would have a minor, less than significant, adverse effect on floodplains.

The Proposed Action would remove trees growing along the tops of existing levees that would be removed (see Section 4.6.1.3.2 for more details). Trees that would be removed would be reused on site, reserved for use in offsite restoration projects, and sold for lumber. Some of the trees would be reused on site to provide large woody debris and habitat structures within the restoration area. The log ends of placed habitat trees would be pushed into the ground for anchoring. Permanent anchoring by piling or other engineered means would not be used. It is not known at this time how many trees will be salvageable or suitable for reuse as habitat logs. These habitat logs may mobilize within the project area during large floods, potentially impeding flood flows by blocking active channels. Some trees would be reserved for use in offsite restoration projects; these trees may be stockpiled for up to 2 years on City property north of the medical center at the west end of First Street in Tillamook. This temporary storage would result in a minor, local, adverse impact on floodplains, which would be less than significant. The reuse of logs for habitat structures on and off site would provide moderate, regional benefits for floodplain functions.

The Proposed Action would include construction of a parking lot for public recreational use at the southeastern corner of the project area following hazardous materials remediation activities. Construction of the parking lot would increase impervious area and might result in minor increases in flood elevations downstream of the parking area during smaller floods, which would be less than significant.

POTB and Tillamook County would be required to coordinate with the local floodplain administrator and obtain any required permits before initiating construction work. All coordination pertaining to these activities and applicant compliance with any conditions would be documented and copies forwarded to the state and FEMA for inclusion in the permanent project files. The full eight-step analysis is documented in Appendix D.

Transition Period

In the first few years following construction, channel changes due to the project are expected in several areas. Blind Slough would enlarge as it becomes an important flood flow channel, conveying flows both from new floodgates in the levee and from the Hall Slough connector channel. Other relic tidal channels would also adjust as they begin to convey tidal flows in and out of the site again. Some lateral movement and change of the main river channels can also be expected where rock armoring would be removed. Channel migration is expected to be relatively minor based on historic patterns.

Vegetation in the construction area would be removed but would reestablish over time via natural passive regeneration. All exposed surfaces on levees would be hydroseeded to stabilize the new levees quickly. The County and POTB would develop a maintenance and monitoring plan as a condition of their grants that will include performance standards and adaptive management components for vegetation. The project would restore floodplain connectivity, and the historical tidal wetland habitats would become reestablished.

Long Term

Hydraulic modeling was completed in 2013 and 2014 using HEC-RAS to evaluate long-term impacts of the Proposed Action; modeling efforts and the effects of the alternatives on flood elevations are described further in Section 4.5.3 and in a technical memorandum in Appendix E.

Hydraulic modeling of the Proposed Action shows that implementation of the Proposed Action would reduce floods over 3,000 acres and would encompass the lower Wilson, Trask, and Tillamook rivers' floodplains. Floods would be reduced up to 1.5 feet in the SFC project area during a 100-year event. Along Highway 101, flood elevations would be reduced minimally during a 1.5-year event, approximately 0.25-0.50 feet lower during a 5-year event, and approximately 1 foot lower during the 100-year event. Although the change in water depth would be minimal along Highway 101 during the 1.5-year event, flood reduction benefits would be realized upstream of Highway 101. The Proposed Action primarily would reduce flood levels between Hall Slough and the Wilson River. **Figure 4.5-4** shows the predicted changes in floodwater depths under the Proposed Action for the 2001 flood (approximately a 1.5-year event). **Figure 4.5-5** shows the predicted changes in floodwater depths for the 1999 flood (approximately a 5-year event). **Figure 4.5-6** shows the predicted changes in floodwater depths for the 100-year flood. Additional modeled predictions of floodwater depths with and without the Proposed Action may be found in Appendix K.

Under the Proposed Action, some areas that currently flood would no longer flood, as shown in pink on **Figures 4.5-4, 4.5-5, and 4.5-6**. Implementation of the Proposed Action would result in 191.55 acres that would no longer flood in a 1.5-year (2001) flood, 128.15 acres in a 5-year (1999) flood, 178.10 acres in a 22-year (2007) flood, and 64.45 acres in a 100-year flood.

The Proposed Action would not adversely affect the functions and values of the 100-year floodplain. No habitable structures would be constructed within the floodplain. The alternative would construct 1.4 miles of new setback levees within the floodplain and would modify 2.8 miles of levees. The total length of the new levees would be much less than the length of the levees removed (6.9 miles of levees/roads would be removed). The new levees are required to maintain existing agricultural uses outside of the project area. Although the Proposed Action would reduce risk to homes and businesses near the project area, the project would not facilitate any development within the floodplain.

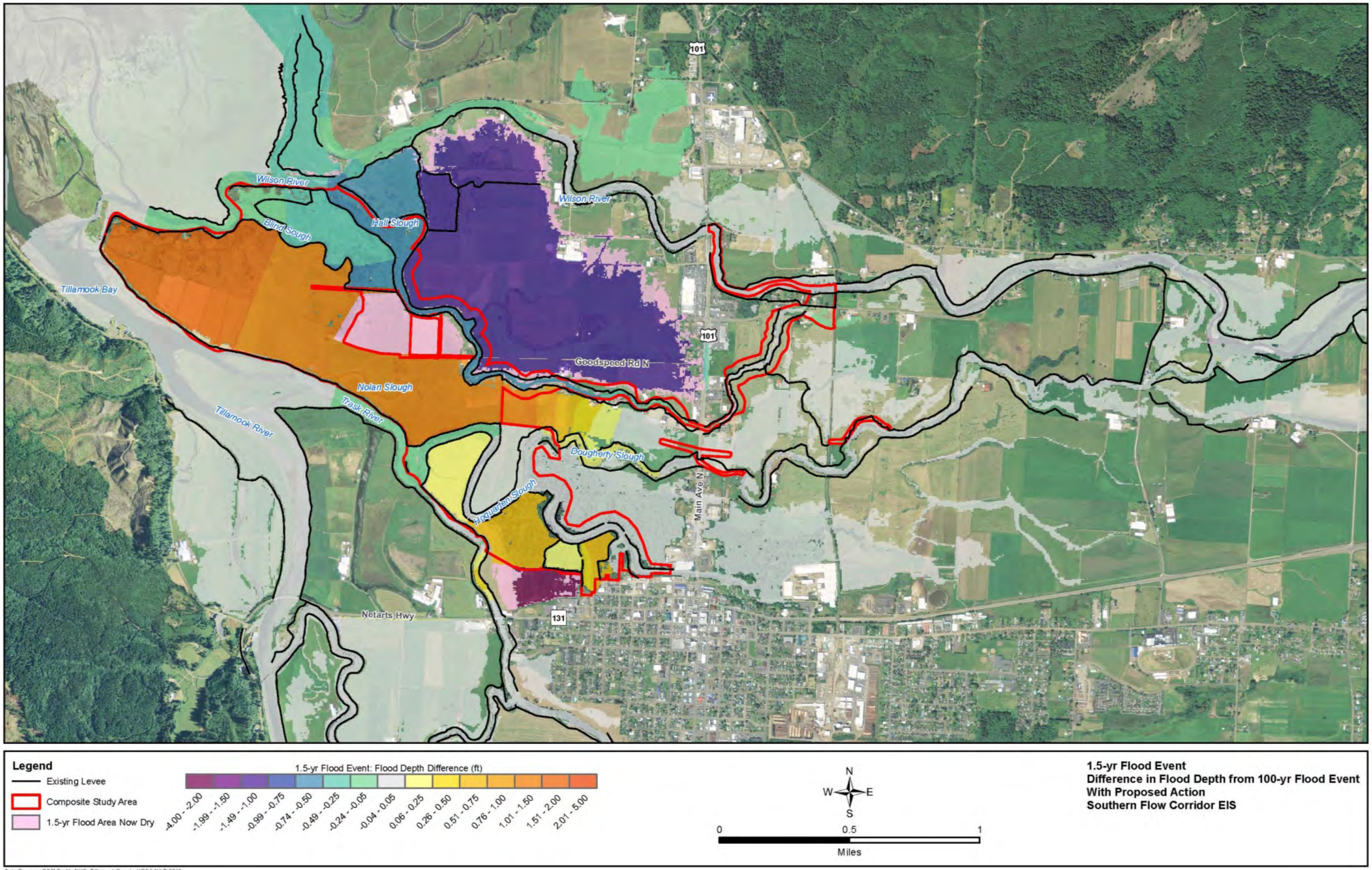
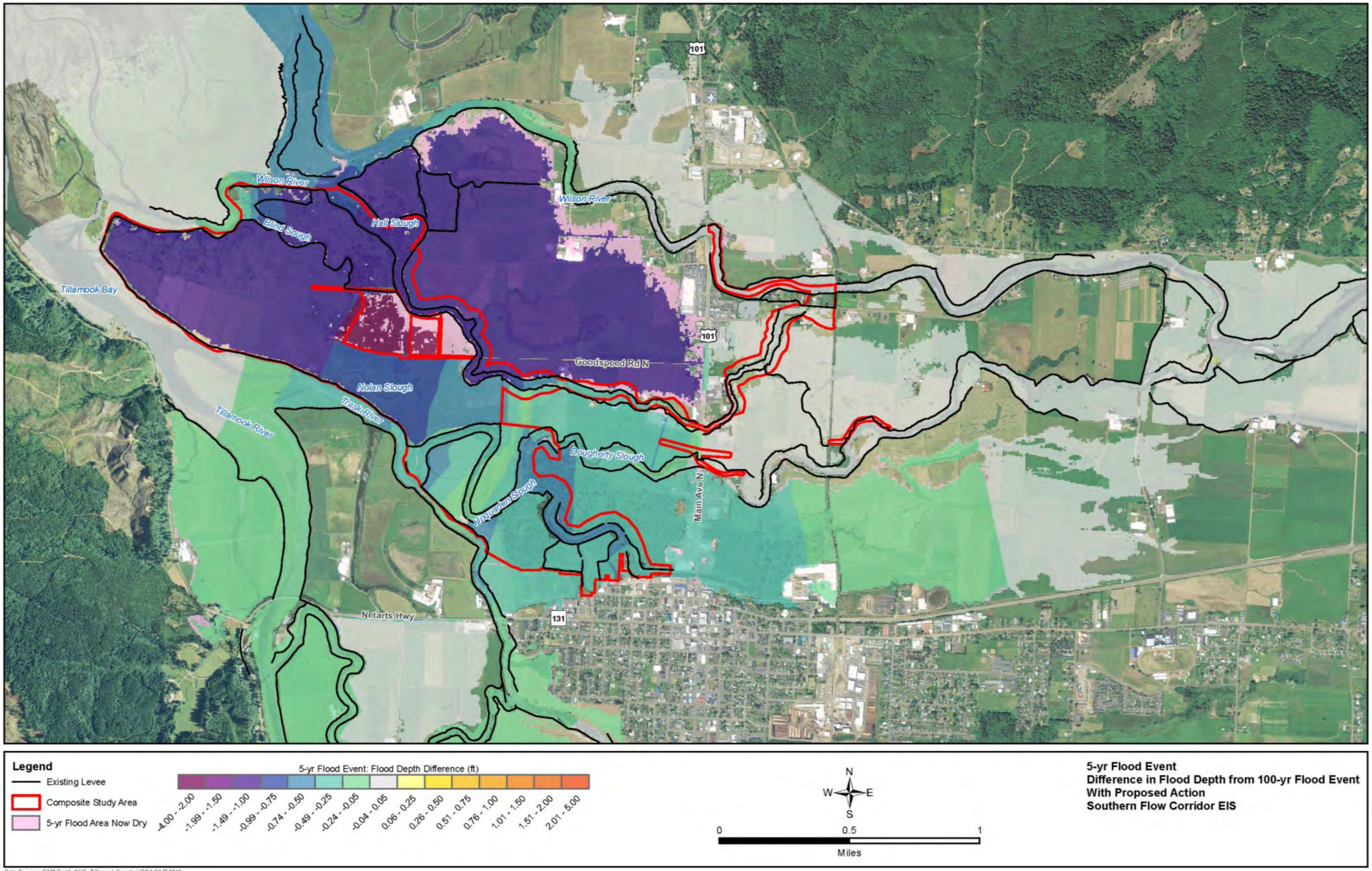
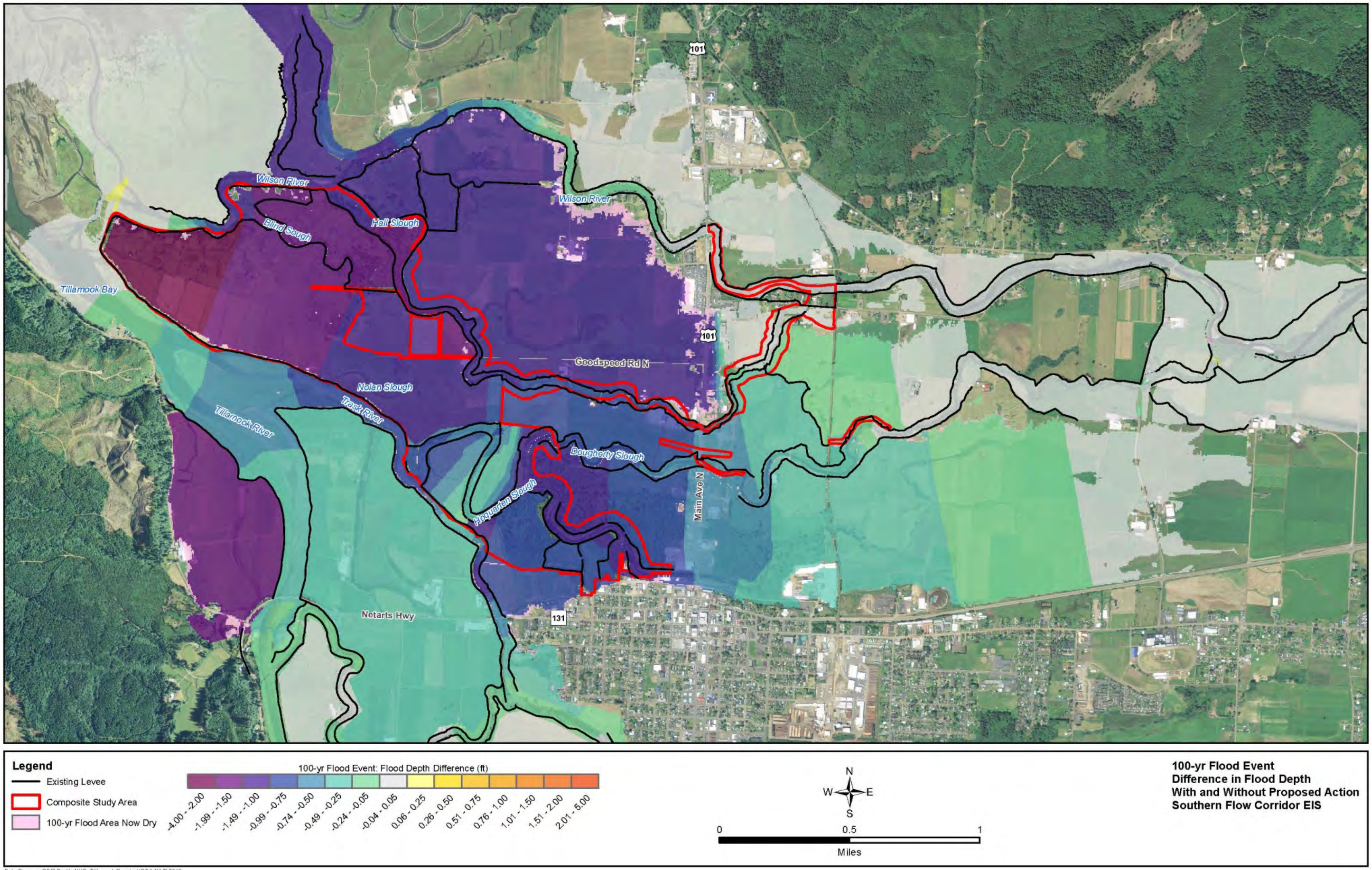


Figure 4.5-4. Predicted Change in Flood Depths under the Proposed Action for a 1.5-year Flood



Data Sources: CDM Smith, NHC, Tillamook County, USDA NAIP 2012

Figure 4.5-5. Predicted Change in Flood Depths under the Proposed Action for a 5-year Flood



Data Sources: CDM Smith, NHC, Tillamook County, USDA NAIP 2012

Figure 4.5-6. Predicted Change in Flood Depths under the Proposed Action for a 100-year Flood

The Proposed Action would increase flood levels immediately east of the new middle levee during small floods. This area is used as pasture and currently prone to flooding. The middle levee would create a smaller area for floodwaters to move into. During smaller, more frequent floods, flows between Hall and Dougherty sloughs would fill this reduced storage area more rapidly. Although the new levee would have a substantially larger floodgate capacity, the floodgates would not begin to operate until water levels inside exceed those outside; therefore, water levels would quickly rise to somewhat above the flood/tide level outside. The floodgates would then begin to operate and discharge water. It is important to note these increases would only occur in very small floods; in larger floods, the area would benefit from flood level reductions similar to the rest of the floodplain. In the long term, the Proposed Action would enhance the natural and beneficial values of the floodplain.

Implementation of the Proposed Action would improve the natural and beneficial functions of these floodplains, including providing flood storage and conveyance, filtering nutrients and impurities from runoff, reducing flood velocities, reducing flood peaks, moderating water temperatures, reducing sedimentation, promoting infiltration and aquifer recharge, and reducing frequency and duration of low surface flows. The proposed action would reconnect the floodplain with its associated rivers and sloughs and restore connections to the bay and estuarine functions. The Proposed Action is also expected to increase the amount of off-channel habitat and integration of the floodplain with the hydrologic regimes of tides, riverine flow, and flood events. The Proposed Action would also reduce flood damages in the City of Tillamook and along Highway 101.

Summary of Effects

Under the Proposed Action, moderate, local, adverse impacts would occur within the floodplain during construction and the transition period. The Proposed Action would comply with all required permits, vegetation in the construction area would reestablish over time, and there would be no development within the floodplain. Therefore, adverse impacts to floodplains during construction would be less than significant.

The Proposed Action would have a moderate, regional, beneficial effect on flood elevations in parts of the Tillamook Valley, specifically by reducing flood levels along Highway 101 during larger flood events. The Proposed Action would have a major beneficial effect on floodplain functions, including floodplain connectivity. Over the long-term, the Proposed Action would have a major local beneficial effect on floodplains by restoring their natural and beneficial values and reducing flood damages in and around the City of Tillamook.

4.5.1.3.3 Alternative 2: Hall Slough Alternative

Construction and Transition Period

Vegetation along Hall Slough would be removed with the initial widening and levee setback construction during construction of Alternative 2 but would reestablish naturally over time. The County and POTB would develop a maintenance and monitoring plan as a condition of their grants that will include performance standards and adaptive management components for vegetation.

No habitable structures would be constructed within the floodplain. Although 0.7 miles of new setback levees would be constructed in approximately the same locations within the floodplain under Alternative 2 and 6.3 miles of levees would be modified, the total length of the new levees would be somewhat longer than the existing levees. The new setback levees would need to curve back and forth to wrap around existing structures and tie into existing levees that are not altered. The increased levee length and the widening and deepening of the channel that would occur under this alternative would result in moderate, local, adverse, construction-related and transition period impacts on floodplains that would be less than significant.

POTB and Tillamook County would be required to coordinate with the local floodplain administrator and obtain any required permits before initiating construction work. All coordination pertaining to these activities and applicant compliance with any conditions would be documented and copies forwarded to the state and FEMA for inclusion in the permanent project files.

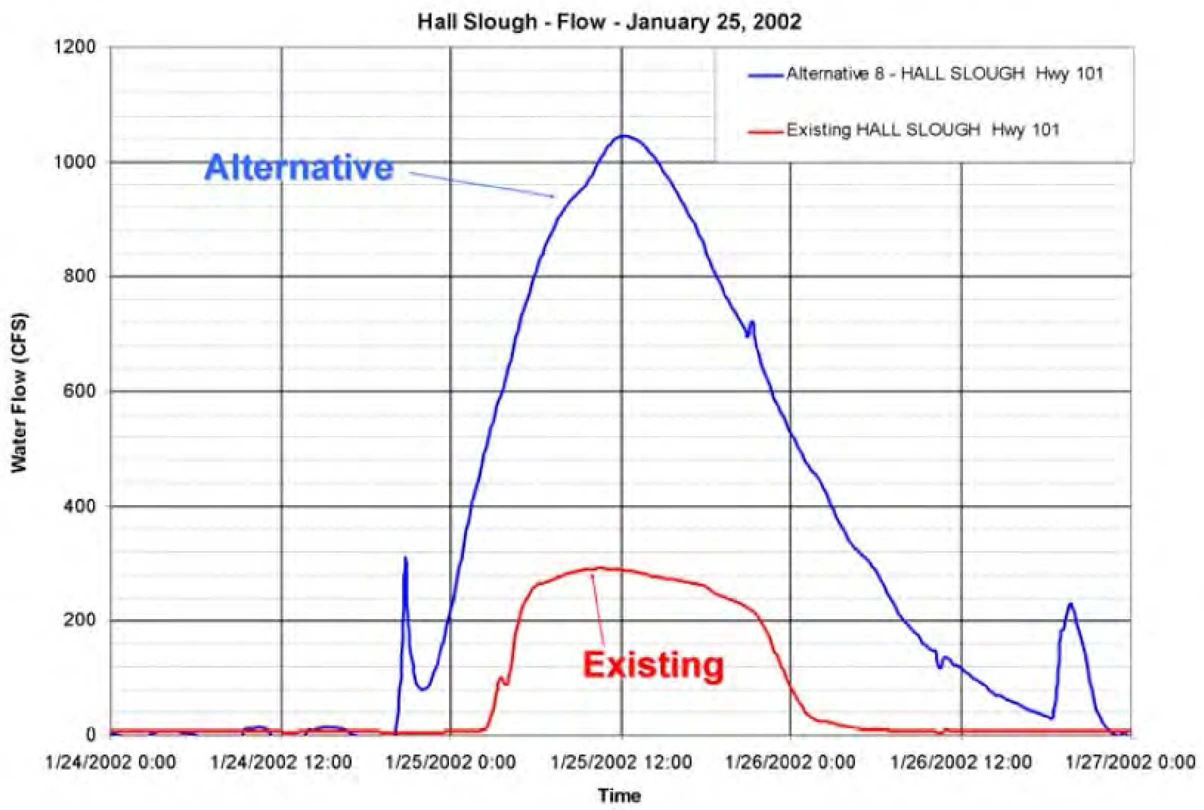
Long Term

Initial modeling of the Hall Slough Alternative under November 1999 flood event conditions (an approximate 5-year flood) using MIKE 11 software showed that Hall Slough would carry approximately 1,000 cfs of floodwater that previously would have flooded Highway 101. By containing this additional flow, implementation of the Hall Slough Alternative would lower the duration of flooding on Highway 101 by approximately 4 hours during an event equivalent to the 1999 flood but would not prevent flooding during this or larger floods. Based on the modeling results, the Hall Slough Alternative would control flooding from frequent, small-scale, “nuisance” floods in the Highway 101 corridor (i.e., the equivalent to up to a 2-year flood), but the alternative would have little effect on the impact of larger floods in the study area.

The January 25, 2002 flood was also modeled, representing an annual event on the Wilson River (i.e., a 1.5 year recurrence interval flood event). Model results showed that Alternative 2 would prevent floodwaters from flowing across Highway 101 and into the fields behind Fred Meyer (2500 Main Avenue). **Figure 4.5-7** shows the amount of water carried within the Hall Slough channel at Highway 101 during that event under the existing conditions and how much might have been carried if the channel were modified as proposed under the Hall Slough Alternative.

Under Alternative 2, periodic dredging of Hall Slough would be required to maintain the design depth because the channel is in a portion of the watershed that is low gradient and tends to aggrade. The dredging would not necessarily affect riparian vegetation if work is conducted with barge-mounted equipment. It is unknown how frequently the channel would need to be dredged, but it is possible that dredging would be needed as frequently as every 2 to 5 years.

Over the long term, the Hall Slough Alternative would result in minor beneficial effects on floodplain connectivity and habitat functions in the project area. The alternative would have no effect on vegetation and floodplain functions of the regional floodplain or the SFC area.



Source: USACE 2004b

Figure 4.5-7. Hall Slough Channel Capacity Comparison of Existing and Hall Slough Alternative

Summary of Effects

Adverse construction-related impacts of Alternative 2 on floodplains would be moderate due to the increased levee length and the widening and deepening of the channel. Permit compliance would reduce construction-related impacts as practicable, and vegetation would reestablish naturally over time. There would be no new development within the floodplain. Therefore, adverse construction-related and transition period impacts to floodplains would be local and less than significant. The long-term beneficial effects of Alternative 2 on floodplains would not be as great as under Alternative 1 but would be greater than under the No Action Alternative. The Hall Slough Alternative would have a minor, local, beneficial effect on flood elevations along Highway 101 and a minor, regional, beneficial effect on floodplain functions.

4.5.1.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction and Transition Period

Alternative 3 would be very similar to the Proposed Action. Construction would occur at approximately the same time as under the Proposed Action and may include the use of a trestle bridge over Hoquarten Slough with similar moderate, local, construction-related and transition-period impacts on the floodplain. Permit compliance would reduce construction-related impacts to the extent practicable. Vegetation in the construction area would be removed but would be expected to reestablish naturally over time. The County and POTB would develop a maintenance and monitoring plan as a condition of their grants that will include performance standards and adaptive management components for vegetation. Impacts would be less than significant.

POTB and Tillamook County would be required to coordinate with the local floodplain administrator and obtain any required permits before initiating work. All coordination pertaining to these activities and applicant compliance with any conditions would be documented and copies forwarded to the state and FEMA for inclusion in the permanent project files.

Long Term

Similar to the Proposed Action, over the long term, Alternative 3 would result in a major benefit to natural floodplain functions and values. Over the long term, tidal channels within the project area would be expected to become re-established, similar to the effect under the Proposed Action. Alternative 3 would restore floodplain connectivity, and the historic tidal wetland habitats would become reestablished. In the long term, Alternative 3 would enhance the natural and beneficial values of the floodplain.

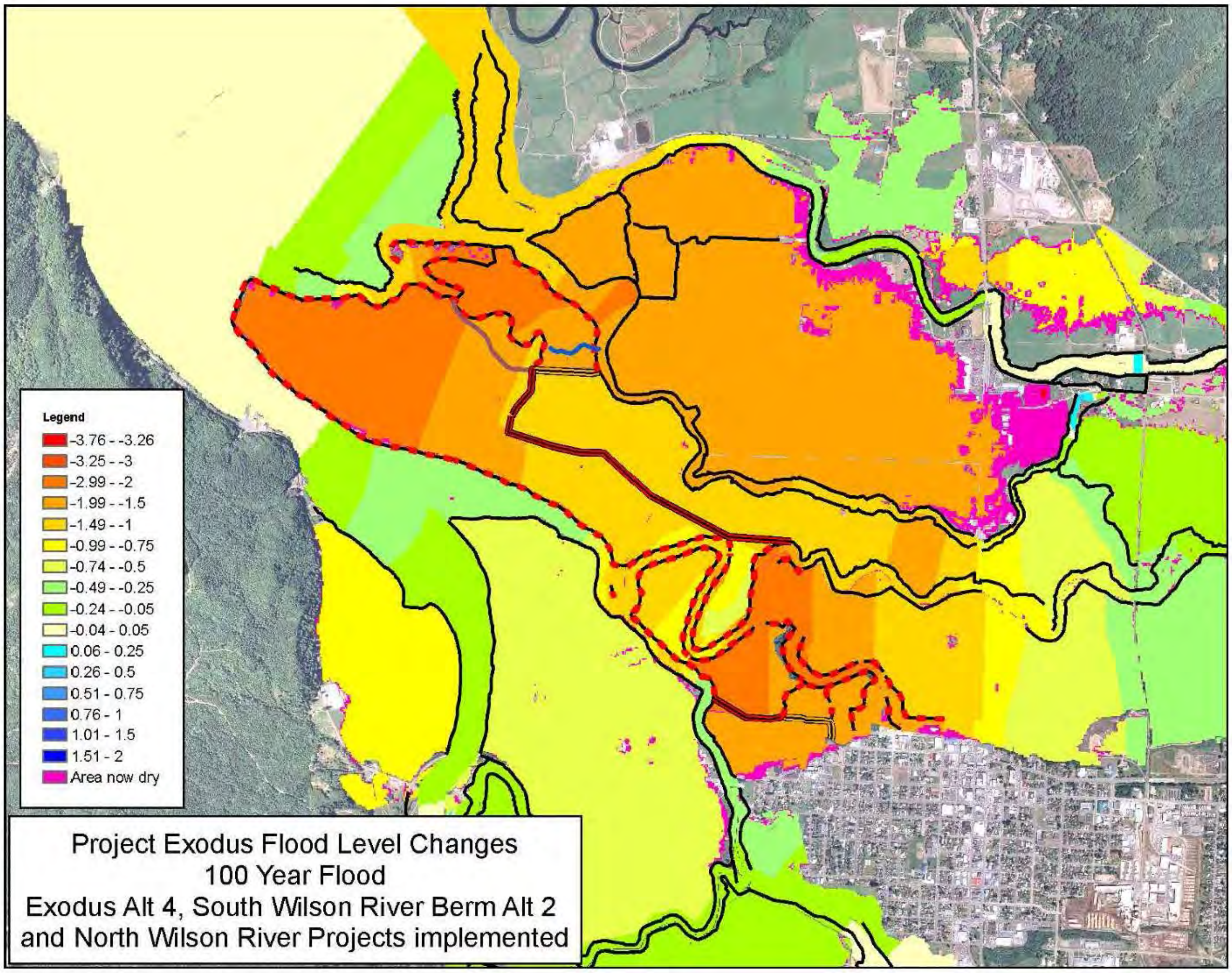
Alternative 3 would not adversely impact the functions and values of the 100-year floodplain. No habitable structures would be constructed within the floodplain. The alternative would construct 1.6 miles of new setback levees within the floodplain and would modify 0.7 miles of levees, but the total length of the new levees would be much less than the length of the levees removed (8.8 miles of levees would be removed). The new levees are required to maintain existing agricultural uses outside of the project area. Although Alternative 3 would reduce risk to homes and businesses near the project area, the alternative would not facilitate any development within the floodplain.

Alternative 3 would provide flood level reductions across most of the lower Wilson River floodplain, similar to the Proposed Action. Some small flood reductions would also extend up the Tillamook and Trask rivers systems. Alternative 3 would reduce flood levels in the area between Hall Slough and the Wilson River similar to the Proposed Action. **Figure 4.5-8** shows predicted changes in flood elevations under Alternative 3 for an approximately 100-year event.

Under Alternative 3, flood levels during smaller floods (e.g., 1.5-year flood events) would be higher in localized areas just inside the new levee system north of the SFC area. Currently, the SFC project area benefits from the large flood storage volume available in the agricultural lands in the western portion of the study area. During smaller, more frequent floods, the flows between Hall and Dougherty sloughs would fill this reduced storage area more rapidly. Although the new levee would have substantially larger floodgate capacity, the floodgates would not begin to operate until water levels inside exceed those outside, so water levels would quickly rise to somewhat above the flood/tide level outside.

Summary of Effects

Adverse construction-related and transition period impacts of Alternative 3 on floodplains would be moderate and local. Compliance with permits would be required. Vegetation in the construction area would be allowed to reestablish naturally over time, and there would be no development within the floodplain. Therefore, adverse construction-related and transition-period impacts to floodplains would be less than significant. Over the long term, Alternative 3 would restore a larger area of floodplain than the Proposed Action, but Alternative 3 would have fewer flood reduction benefits than the Proposed Action. Alternative 3 would result in a major beneficial long-term effect on the floodplain.



Source: NHC 2009

Figure 4.5-8. Predicted Change in Flood Elevations under the SFC – Initial Alternative (100-year Flood)

Notes:

- *The color range and depth intervals are not directly comparable to the figures in Section 4.5.1.3.2, so caution should be used in making comparisons.*
- *Note that the area east of 101 and south of the Shilo levee is shown as not flooding due to the South Bank Wilson River berm project, which was included in the modeling conducted to produce this figure but which is not included in Alternative 3 as defined in this EIS.*
- *The water level reductions shown on the North Bank Wilson in this figure are due to the North Bank Wilson River project, which also is not included in Alternative 3 as defined in this EIS. The SFC – Initial Alternative does not provide benefits here.*
- *See NHC 2009 for information on other flood recurrence intervals.*

4.5.2 Wetlands

EO 11990, Protection of Wetlands, requires federal agencies to take action to minimize the loss of wetlands. Activities that disturb jurisdictional wetlands require a permit from USACE under Section 404 of the Clean Water Act of 1977 (33 U.S.C. 1344).

FEMA regulation 44 CFR 9, Floodplain Management and Protection of Wetlands, sets forth the policy, procedures, and responsibilities to implement and enforce EO 11990 and prohibits FEMA from funding construction in a wetland unless no practicable alternatives are available. To comply with EO 11990, FEMA uses the eight-step decision-making process in 44 CFR 9.6 to evaluate actions that have potential to affect wetlands. The eight-step process is combined with the analysis for floodplain impacts and is summarized in Section 4.5.1 and further described in Appendix D.

4.5.2.1 Methodology

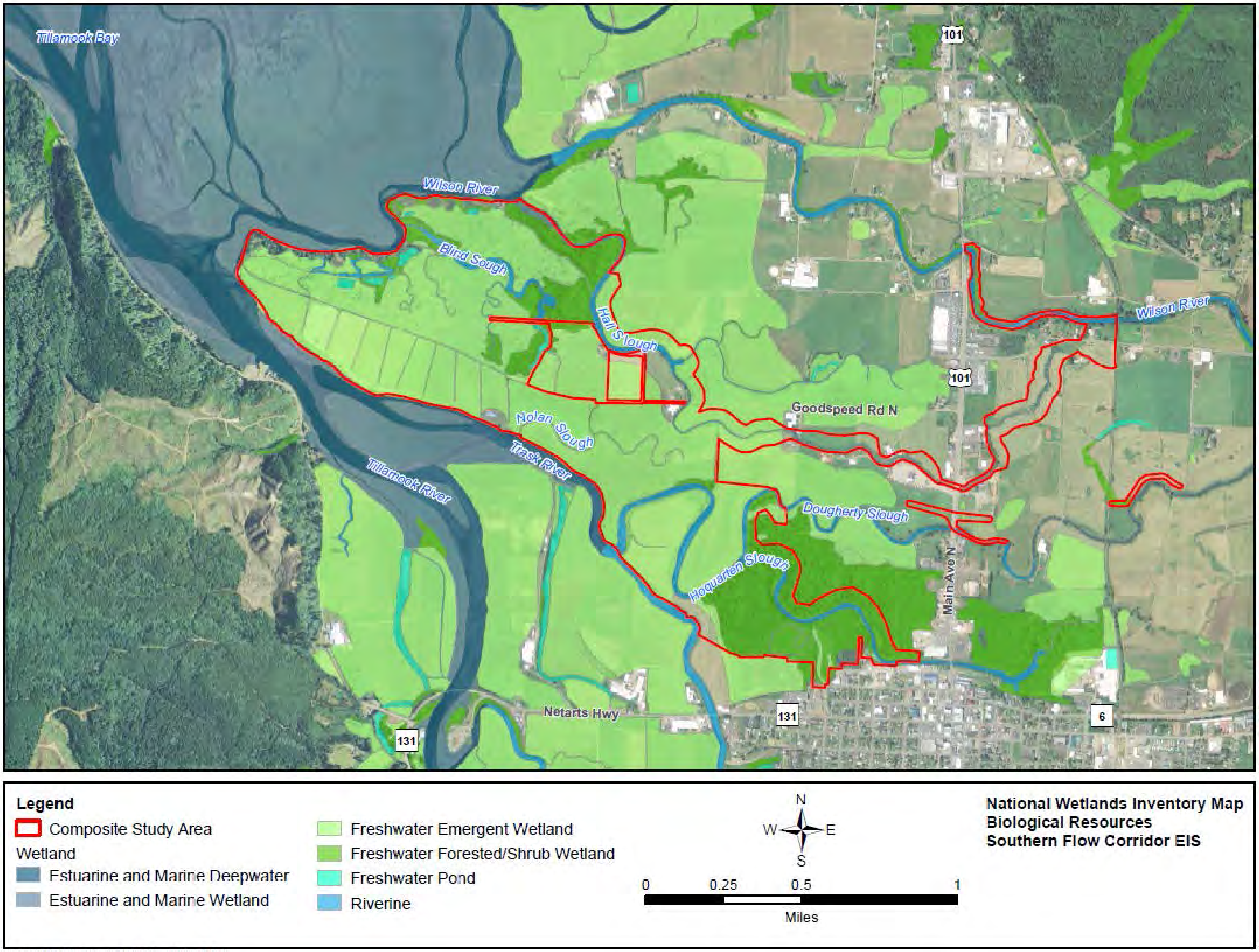
To determine potential impacts on wetlands, existing wetland data from the USFWS National Wetlands Inventory (NWI) and other literature on the study area was reviewed. POTB and Tillamook County completed a wetland delineation of the SFC study area focusing on areas that could be affected by construction proposed under the Proposed Action. Wetland size was estimated using aerial photographs and study area boundaries. A general field reconnaissance was conducted on June 30, 2014 to confirm the presence and extent of potential wetland areas. In addition, Tillamook County performed field explorations, laboratory testing, and geotechnical engineering analysis for Alternative 1.

4.5.2.2 Affected Environment

Historical wetlands in the Tillamook Bay area included tidal marshes, lower wooded tidelands, and river floodplain bottomlands (Coulton et al. 1996). Tidal marsh was found in the marine and brackish zones of the estuary and was dominated by grasses or other low growing non-woody vegetation. Lower wooded tidelands, also referred to as tidal swamps, were located farther up the estuary immediately adjacent to tidal marshes. Tidal swamps are dominated by woody vegetation (trees and shrubs) (Ewald and Brophy 2012). River floodplain bottomlands were located even farther upslope and extended east from the tidal swamps to the eastern end of the Tillamook Valley. Two types of river floodplain bottomlands were present: those within the area of typical tidal influence and those beyond the upper extent of tidal influence (Coulton et al. 1996). River floodplain bottomlands were dominated by freshwater to saline tolerant woody vegetation.

Wetlands within the project area have been subject to varying degrees of human modification since the 1850s when the area began to be developed. An estimated 86 percent of the 6,035 acres of historical tidal wetlands in the Tillamook Bay estuary have been lost to urban and agricultural development (TBNEP 1999). The USFWS NWI database was used to identify wetlands in the study area. NWI mapping is based on aerial photo interpretation; therefore, it typically presents a broad-level identification of wetland areas. The NWI identifies five wetland types within the study area. Wetland types, as identified by NWI, are presented in **Table 4.5-2** and shown on **Figure 4.5-9**. **Table 4.5-2** also presents the acreages of wetland types found in the study area based on the wetland delineation (MCS Corp and Latimer Environmental 2015), as described below.

Approximately 70 percent of the study area is identified as freshwater emergent wetland, and approximately 23 percent is shown as freshwater forested/shrub wetland (USFWS 2014c). The western portion of the Hall Slough Alternative project area also contains freshwater emergent wetlands, and the eastern portion is upland (**Figure 4.5-9**).



Data Sources: CDM Smith, NHC, USFWS, USDA NAIP 2012

Figure 4.5-9. Wetland Resources in and Near the Study Area

The City of Tillamook Local Wetland Inventory (LWI) maps wetlands and possible wetlands within the City of Tillamook urban growth boundary (UGB). The southeastern portion of the project area lies within the UGB, and the LWI identifies wetlands in this area (Wilson et al. 1997). The wetlands identified in the LWI are the same as those identified in the NWI.

Table 4.5-2. Existing Wetlands within the SFC Project Area

NWI Wetland Class	Delineated Wetlands [1]	Area (acres)
Freshwater Emergent Wetland	Farmed Herbaceous Wetland	418.9 [2]
	Unfarmed Herbaceous Wetland	126.5
Freshwater Forested/Scrub-shrub	Scrub-shrub Wetland	31
	Forested Wetland	67.5
Estuarine and Marine Wetland	Saltwater Wetlands	21.5
Riverine/Freshwater Pond	Other Waters	44 [3]

1 – MCS Corp and Latimer Environmental 2015; Wetland Delineation Report wetland type descriptors.

2 – The draft Wetland Delineation Report currently includes riverine areas and waterways in the total area of freshwater emergent wetland for a total of 462.9 acres. The exact area of riverine wetlands and waterways was not determined in the draft delineation report. For the purposes of this Draft EIS, the total area of NWI-mapped freshwater pond and riverine habitat, 6.5 and 37.5 acres, respectively, was used for those open water wetland classes. The total NWI riverine/freshwater pond classes were subtracted from the total acreage in the Delineation Report (462.9 acres) to derive the total area of freshwater emergent/farmed herbaceous wetland.

3 – Acreage from NWI mapping.

4.5.2.2.1 Wetland Classes Present within the Study Area

Ground-level studies indicate wetland vegetation communities within the study area include freshwater emergent, scrub-shrub, and forested communities as well as some remnant tidal wetland communities (Brophy 2014a, 2014b; MCS Corp and Latimer Environmental 2015; Wilson et al. 1997). A summary of wetland types present within the study area is provided below followed by more detailed information available for selected portions of the study area.

The NWI mapping identifies "freshwater forested/shrub wetland" as one wetland type; however, based on field investigation, this wetland type was further broken down into two classes: scrub-shrub wetlands and forested wetlands.

Freshwater Emergent Wetlands

Emergent wetlands within the project area include actively managed agricultural areas (including hayfields and pastures) and inactive or abandoned pastures (MCS Corp and Latimer Environmental 2015; Brophy 2014a, 2014b). Brophy (2014a, 2014b) describes three emergent wetland vegetation community types in the study area (see **Figure 4.6-1** in Section 4.6.1, Vegetation):

- **Diked emergent wetland, cropped** (**Figure 4.6-1**, Map ID: 1)
    - Located along the Trask River.
    - Vegetation is dominated by meadow foxtail (*Alopecurus pratensis*) and reed canarygrass (*Phalaris arundinacea*).

- **Diked emergent wetland, active pasture** (**Figure 4.6-1**, Map ID: 2)
  - Located in the southeast portion of the study area along Hoquarten Slough where there is actively used pasture (Brophy and van de Wetering 2014).
  - Vegetation is dominated by reed canarygrass, Pacific silverweed, soft rush (*Juncus effusus*), or transitional wetland to upland areas dominated by tall fescue (*Schedonorus arundinacea*).
- **Diked emergent wetland, inactive/abandoned pasture (Figure 4.6-1**, Map ID: 3)
  - Located south of and adjacent to Blind Slough; this area has been managed for waterfowl after the cessation of agricultural activities and includes a series of excavated water features (Brophy and van de Wetering 2014).
  - Dominated by reed canarygrass, slough sedge (*Carex obnupta*), common cat-tail (*Typha latifolia*), creeping spikerush (*Eleocharis palustris*), and Pacific silverweed.

Preliminary results of vegetation monitoring (Brophy and Brown 2015) indicate the majority of freshwater emergent wetlands within the study area are dominated by non-native grasses and forbs. Non-native species account for approximately 75 percent total cover of vegetation and include reed canarygrass, spreading bentgrass, meadow foxtail, spotted touch-me-not (*Impatiens capensis*), bird's-foot trefoil (*Lotus corniculatus*), and tall fescue. The dominant non-native species is reed canarygrass at approximately 50 percent cover. Total cover of native vegetation is less than 20 percent. The dominant native vegetation is slough sedge at approximately 7 percent cover. Other native vegetation present includes tufted hairgrass, soft rush, Pacific water parsley (*Oenathe sarmentosa*), and common silverweed, together accounting for approximately 10 percent of the total vegetation cover. The wetland delineation documented reed canarygrass, colonial bentgrass, soft rush, tall fescue, velvetgrass, Italian ryegrass (*Lolium perenne*), and meadow foxtail. Farmed wetland areas were dominated by reed canarygrass, colonial bentgrass, soft rush, and slough sedge in the unfarmed wetland areas (MCS Corp and Latimer Environmental 2015).

Scrub-Shrub Wetlands

Patches of scrub-shrub wetlands are present primarily along ditches, fencerows, and field edges throughout the SFC project area. One scrub-shrub wetland community is in the northwestern portion of the study area, north of Blind Slough. This area was not diked until the 1960s and was historically mapped as a tidal marsh; it has converted to a freshwater wetland with water levels regulated by tide gates. Although the area appears to have been used as pasture in the more recent past, grazing currently appears to be limited or non-existent.

Scrub-shrub wetland vegetation within the study area generally consists of dense shrub communities that developed following the clearing of spruce forests. The dominant vegetation is comprised of willow, salmonberry, sword fern, red elderberry (*Sambucus racemosa*), and huckleberry (*Vaccinium* spp.), with the relative dominance varying with site conditions (E&S Environmental Chemistry, Inc. 2001). The area is densely vegetated with predominantly woody vegetation. This vegetation community is categorized by Brophy (2014b) as:

- **Diked scrub-shrub wetlands, non-pasture** (**Figure 4.6-1**, Map ID: 4)
    - Vegetation is dominated by Hooker's willow or red elderberry.

Freshwater Forested Wetlands

Most of the tidal forest in Oregon was probably tidal spruce swamp (also referred to as tideland spruce meadow) because the dominant tree is generally Sitka spruce (Jefferson 1975). Forested vegetation communities within the study area consist of remnant patches of historical tidal spruce swamp, a rare plant community in Oregon (Jefferson 1975), and occasional hardwood stands.

Tree surveys of portions of the study area have identified two primary tree species, Sitka spruce and red alder. Each of these species is dominant where they occur and limited in overlap.

Tidal spruce swamp is currently found in very limited areas of the Tillamook lowlands. The area between Hoquarten and Dougherty sloughs in the easternmost portion of the study area contains one of the few remaining intact tidal swamps in the Tillamook Bay estuary (Ewald and Brophy 2012) and is the largest remaining tidal forested swamp in the area (Wilson et al. 1997; Brophy 1999; Tillamook Estuaries Partnership [TEP] 2010). The northwest portion of the site along Hall Slough has naturally higher elevations and supports a Sitka spruce tidal swamp (Brophy and van de Wetering 2014; Brophy 1999). In addition to Sitka spruce, vegetation within these wetlands primarily consists of willows (*Salix* spp) and salmonberry, with slough sedge in the understory (MCS Corp and Latimer Environmental 2015).

This vegetation community is categorized by Brophy (2014b) as:

- **Diked forested wetlands: Sitka spruce, tidal** (**Figure 4.6-1**, Map ID: 5)
    - Vegetation is dominated by Sitka spruce and is currently tidally influenced.
- **Diked forested wetlands, non-pasture: red alder** (**Figure 4.6-1**, Map ID: 7)
    - Vegetation is dominated by red alder.

Estuarine and Marine Wetland

A small area of estuarine emergent wetland is mapped (on NWI maps) near the mouth of Hall Slough in the northwestern portion of the study area.

Riverine Wetland

A riverine wetland includes all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens and (2) habitats with water containing ocean-derived salts in excess of 0.5 percent. A riverine wetland is bounded on the landward side by upland, by the channel bank (including natural and man-made levees), or by wetland dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens (Cowardin et al. 1979). The NWI maps Blind, Dougherty, and Hoquarten sloughs as riverine wetlands within the study area.

The wetland delineation documented numerous sloughs, canals, and manmade ditches within the study area (MCS Corp and Latimer Environmental 2015). Typical agricultural ditches consist of steep to vertical banks vegetated by reed canarygrass, slough sedge, spreading rush (*Juncus* *patens*), and aquatics such as water milfoil (*Myriophyllum* sp) and duckweed (*Lemna* sp). These trapezoidal ditches are generally linear and designed to drain agricultural fields.

Freshwater Pond

The NWI maps identify freshwater ponds in the northwestern portion of the study area. South of and adjacent to Blind Slough, a large area has been managed for waterfowl after the cessation of agricultural activities, and this area includes a series of excavated water features (Brophy and van de Wetering 2014).

4.5.2.2.2 Additional Site Information

Tidal Wetland Prioritization for the Tillamook Bay Estuary (2012)

The *Tidal Wetland Prioritization for the Tillamook Bay Estuary* (Ewald and Brophy 2012) describes tidal wetlands present in the Tillamook Bay estuary. Ewald and Brophy prioritized wetland areas in the Tillamook Bay estuary based on size, tidal channel conditions, wetland connectivity, salmonid diversity, historical wetland type, and diversity of vegetation classes. While Ewald and Brophy prioritize sites to assist in conservation and restoration planning, the authors stress that "no tidal wetland is unimportant" and recommend conservation of all existing tidal wetlands. Restoration of tidal wetlands is considered important as well, regardless of priority ranking. The rankings indicate no regulatory significance or intent but are intended to provide a strategic approach to conservation and restoration of wetlands in the Tillamook Bay estuary. Four areas within the SFC project area were classified as high priority as described below.

- The area north of Blind Slough has been mapped as a tidal marsh as far back as the 1800s. This area most likely served as pasture at some point in the past, but based on the significant woody vegetation, current grazing is minimal.
- The strip of land along the south bank of Hall Slough on the northern edge of the study area is an intact tidal swamp and appears to be unaltered since 1939.
- Between Hoquarten Slough and the Trask River (the area south and east of where Hoquarten Slough joins the Trask River), the area is described as an agricultural site and former tidal swamp. Levees and tide gates restrict tidal flow into the northern part of this area; however, the southeastern portion of this site is tidal, probably receiving flow from Hoquarten Slough through a breach in the levee.
- A tidal swamp is located between Dougherty and Hoquarten sloughs. This area is considered fully tidal and contains larger sinuous tidal channels with no apparent in-channel flow restrictions (e.g., no tide gates and culverts). The natural levee along Dougherty Slough does not affect tidal inundation via Hoquarten Slough. Hoquarten Slough appears to be the main source of tidal flows.

Southern Flow Corridor Project Effectiveness Monitoring Plan (2014)

The *Southern Flow Corridor Project Effectiveness Monitoring Plan* (Brophy and van de Wetering 2014) divides the project area into four zones for purposes of monitoring the effectiveness of the SFC project based on current land use.

- **North Wetland Zone** – The northern portion of the SFC area, north of Blind Slough, is a relatively less intensively altered, freshwater wetland area. This area appears not to have been farmed although it probably has been grazed in the past. Blind Slough, thought to be a historical channel of the Wilson River, was disconnected for many years from the Wilson River by constructed levees. Its connection with the Wilson River has recently been partially restored with the installation of new culverts and tide gates. Sowers and Trenholm (2001) characterize this area as freshwater wetlands with some upland areas associated with dredge spoil piles adjacent to the Wilson River. They also document a stand of mature spruce forest in the northwestern portion of this zone. Levees surrounding this zone appear to be failing in places; however, tidal exchange continues to be limited (Sowers and Trenholm 2001).

- **Middle Wetland Zone** – The central portion of the SFC area, to the north of Goodspeed Road and south of Blind Slough, is primarily abandoned pastureland. In the past, this area was actively managed as pasture, but it retains many relic channel remnants. Sowers and Trenholm (2001) characterize this area as predominantly freshwater wetlands with isolated patches of wooded upland. Remnant tidal changes present in this area are partially or entirely blocked from tidal exchange. This area shares a common dike with the South Wetland zone. Areas of the invasive species Scot's broom are found in this zone in association with piles of dredge spoils from a 1972-73 USACE dredging project (Sowers and Trenholm 2001). Manmade freshwater ponds, originally created to enhance waterfowl habitat, are scattered throughout this zone.

- **South Wetland Zone** – The southern portion of the SFC area, south of the centerline ditch and adjacent to the Trask River, is actively farmed land, which is intensively managed for hay crops. This area is also heavily ditched and drained. Sowers and Trenholm (2001) describe this area as farmed freshwater wetland, currently used as pasture. This area contains an extensive system of linear and manmade drainage ditches that terminate at floodgates at the western end of this zone. The Wilson River levee system borders the southern and western edges of this zone adjacent to the Trask River. Several piles of dredge spoils are located on the southern edge of the levee near the Trask River (Sowers and Trenholm 2001).

- **North Slough Wetland Zone** – The area around Nolan Slough in the eastern portion of the SFC study area is currently active pasture with more ditching than the Middle Wetland zone but less than the South Wetland Zone area. The lower portion of Nolan Slough is an estuarine channel (Sowers and Trenholm 2001).

4.5.2.3 Environmental Consequences

Based upon the regulatory framework established by the regulations discussed in Section 4.5.2, and using the impact scale described in **Table 4.1-1**, FEMA performed a qualitative evaluation to evaluate potential impacts on wetlands. For the purpose of this EIS, a significant adverse impact would result if the alternative would cause the destruction, loss, or degradation of wetlands resulting in a net loss of functional values.

Wetlands contribute critical functions to watershed health, including water quality improvement, filtration, flood attenuation, groundwater recharge and discharge, and fish and wildlife habitats.

Tidal wetlands are among the most productive ecosystems in the world (Mitsch and Gosselink 1993). TBNEP (1999) prioritized floodplain and lowland restoration sites within the Tillamook Bay area based on these criteria: habitat connectivity, high quality instream or riparian habitat, riparian trees, multiple benefits for habitat, water quality, erosion, and flood protection (TBNEP 1999).

Table 4.5-3 provides a summary of the expected acres of restored wetland by alternative.

Table 4.5-3. Potential Tidal Wetland Restoration Acreage by Alternative

Alternative	Wetland Restoration (acres)
No Action Alternative	0
Southern Flow Corridor – Landowner Preferred Alternative	522
Hall Slough Alternative	90
Southern Flow Corridor – Initial Alternative	568

4.5.2.3.1 No Action Alternative

Construction

There would be no construction activities as part of the No Action Alternative; therefore, there would be no construction-related impacts on wetlands.

Transition Period

Under the No Action Alternative, the existing mix of vegetation communities, wetland classes, habitat types, and species would be unaffected and follow present trends and ecological trajectories. Agricultural operations would be phased out on the 392 acres in County ownership (of which approximately 152 acres are in current agricultural production), and the area would gradually convert to a freshwater wetland. Although the timing of this transition period is speculative, it could take as long as 10 years. Over time there would be more acres of freshwater wetland, which could represent a local improvement in floodplain conditions. Overall, there would be moderate, local, transition period beneficial effects.

Long Term

Although the No Action Alternative would result in an increase in freshwater wetlands within the project area, the existing conditions of depleted tidal wetland acreage, floodplain discontinuity, and lost estuarine habitat functions would continue to compound impacts on the environment. Over the long term, this would continue to degrade a wide variety of resources such as populations of fish, shellfish, migratory shorebirds, and water quality. The project area may be less resilient to the effects of climate change and sea level rise. Therefore, the reduction in tidal wetlands in the estuary over the long term would continue to be a major, regional, adverse impact that would be significant. Over the long term, non-native and invasive plant species currently in the wetlands likely would increase as a result of seed transported by floodwaters, which would be a minor, local, impact that would be less than significant. Also, under the No Action Alternative, the Sitka spruce stands in the eastern and north-central portions of the SFC area likely would be retained and continue to mature, which would be a minor, local beneficial effect.

4.5.2.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Construction

The Proposed Action would result in temporary, construction-related impacts to the existing environment during construction and tidal marsh restoration activities, including ground disturbance, vegetation removal, heavy equipment operation in wetlands and adjacent to waterways, and site stabilization. Construction of approximately 1.4 miles of new setback levees would result in fill of approximately 10 acres of existing wetland but would also result in a shorter levee length overall (a total reduction of 5.5 miles of levee). Construction of these levees would be considered a fill under state and federal regulations. This fill would result in moderate, local, adverse impacts on freshwater wetlands. The filling of freshwater wetlands would be mitigated by removal of levees in other portions of the project area and the restoration of tidal wetlands resulting in a net increase in total wetland area and function. Therefore, construction impacts would not be significant.

A new connector channel would be constructed to link Hall Slough with Blind Slough, which would result in removal of some existing wetlands and the potential for new wetlands adjacent to the new channel to become established. During construction of the Proposed Action, a temporary trestle or pontoon bridge across Hoquarten Slough may be used to transport materials across the Slough. This trestle or bridge would temporarily affect wetlands in the immediate area, but wetland conditions would return following removal of the trestle or bridge. This bridge would only need to be in place during one construction season. The potential use of a bridge over Hoquarten Slough would result in minor, local adverse effects on the existing degraded freshwater wetlands. Following removal of the bridge and restoration of tidal wetland systems, the impact would not be significant.

Transition Period

The land surface in the study area has subsided by several feet since diking, which is a common occurrence where regular tidal inundation has been eliminated or highly reduced (Simenstad et al. 1999). Therefore, it is likely the land would initially convert to low marsh or tidal mudflats following removal of the levees and reintroduction of tidal fluctuations (Tiner 2013). The Proposed Action would produce a large initial expansion of tidal low marsh and mud flats. With the reintroduction of tides and annual flooding, sediments would be expected to build the restoration area elevations back up (see Section 4.7.1.2). Over time, low marsh communities (i.e., areas that flood and drain twice daily) may convert to high marsh communities (i.e., slightly higher elevations and less frequent tidal flooding) through sediment accretion (Jefferson 1975). It is expected the project area would eventually regain a dynamic equilibrium state in which the tidal wetland system would persist and adjust to the competing forces of sediment accretion and sea level rise.

The transition from a freshwater to an estuarine system would result in a major modification of existing terrestrial and aquatic wildlife habitats, leading to a shift in species composition in the study area (see Section 4.6.2). A large portion of the existing wetlands that would be converted are low quality, pasture wetlands, which currently provide only limited wetland functions. Most of the freshwater wetland and pasture vegetation would not be able to tolerate the saline waters that would enter the site, and that vegetation would quickly die off (NHC 2010). At the Ni-les'tun tidal restoration site in Bandon, Oregon, the change in plant communities was rapid, with significant die-back of the freshwater vegetation in the first year following breaching of the dikes (Brophy and van de Wetering 2012).

Non-native and/or invasive species are often quick to establish in disturbed areas (Tanner et al. 2002; Frenkel 1995). These non-native or invasive species may temporarily dominate during the early years after restoration as compared to reference wetlands. (Reference wetlands for the Proposed Action were identified in the *Southern Flow Corridor Project Effectiveness Monitoring Plan* (Brophy and van de Wetering 2014). This may result from the spread of currently present non-native species or establishment of new non-native species specifically adapted to colonize areas of disturbance. These non-native or invasive species would not be expected to persist in the long term (Cornu and Sadro 2002). As salinity levels increase, they would be expected to die out and eventually be replaced by saline-tolerant native tidal plant species (Smith and Warren 2012). For comparison, at a salt marsh restoration project at the Salmon River along the central Oregon coast in 1978, pasture species rapidly died out and were initially replaced by annual native and non-native marsh colonizers. Within about 4 years, these species began to be replaced by regionally common native marsh species such as Lyngbyi's sedge (*Carex lyngbyei*), salicornia (*Salicornia virginiana*), and saltgrass (*Distichlis spicata*) (Frenkel 1995).

The County and POTB would develop a maintenance and monitoring plan as a condition of their grants that will include performance standards and adaptive management components for vegetation. Natural tidal processes would bring in the water, salinity, sediment, and seeds that would initiate restoration (NHC 2010). Native estuarine plants would become established through natural recruitment with propagules brought by the tidewaters from nearby tidal marshes (Frenkel and Morlan 1991; Rozsa 2012). Wetlands in areas farthest from the bay may receive little or no saline or brackish water; therefore, they may change little from current conditions.

Portions of the spruce forest at lower elevations in the northwest corner likely would die off either through increased salinity, longer hydroperiods, or higher water levels. Trees in the forested wetlands in the southeastern portion of the study area near the City of Tillamook may die off due to higher water levels following levee removal. However, more trees are expected to persist in the southeastern portion because changes in salinity and water levels from re-introduced tides would be less dramatic when compared to areas to the west.

While a return to fully functional tidal wetland conditions would take some time, the study area would be expected to progress gradually through an early period of rapid change toward a fully functioning tidal wetland complex (Simenstad and Thom 1996; Thom et al. 2002). The minimum timeline for full functional replacement would be 5 to 10 years for emergent wetland communities (Kidd and Yeakley 2014; Zedler and Callaway 1999). The replacement wetland would be expected to be predominantly tidal marsh, characterized by herbaceous vegetation. Trees and shrubs would be expected to establish in higher elevation areas on berms and along streams and sloughs that may remain in some small areas of the project area. Soil development may take a decade or longer in the tidally re-connected wetlands (Kidd and Yeakley 2014; Short et al. 2000). At the Salmon Creek salt marsh restoration, native salt marsh vegetation was fully restored within about 8 years following dike removal, with no planting, seeding, or grading (Frenkel 1995). Under the Proposed Action, the transition period would represent a major, local, adverse effect on freshwater wetland systems, but because there would be a net increase in wetland acreage and functions these effects would not be significant.

Long Term
Under the Proposed Action, existing wetlands would be modified, and there would be a major shift in wetland types throughout the project area. Approximately 522 acres of wetlands would be restored to the historical tidal wetland types in the areas reopened to tidal fluctuations where existing levees and fill material would be removed. Removal of approximately 6.9 miles of existing levees would result in additional restoration of a minimum of 50 acres of previously filled wetland, resulting in a net increase in total wetlands within the project area. The total wetland restoration area represents over 9 percent of historical tidal wetlands that have been lost in the Tillamook Bay estuary (TBNEP 1999).

Over time, the majority of the existing wetlands would convert from freshwater emergent wetlands to estuarine tidal wetlands with a saline or brackish water regime. The wetland vegetation communities would transition from pasture and other predominantly non-native vegetation to an assemblage of predominantly native species tolerant of saline or brackish water (Myers 1996; Thom et al. 2002; USFWS 2014a; Warren et al. 2002). No rare or sensitive freshwater plant species are known to occur within the study area; therefore, they would not be affected by the Proposed Action (Oregon Biodiversity Information Center [ORBIC] 2014, USFWS 2015c).

Overall, the Proposed Action would result in increased wetland complexity and availability, providing major, regional ecological benefits, including development of low and high tidal marsh and forested tidal wetland vegetation communities (Tillamook County 2013). Although the changes between the existing wetland communities and the expected future wetland communities would be major, overall impacts on wetlands would be beneficial. These benefits would result because there would be a net increase in the area of wetlands and because vegetation communities would transition naturally from fresh to saltwater vegetation communities, which provide greater functions and values on the edge of the bay.

Restoration of tidal wetlands through tidal reconnection and removal of flow barriers, such as dikes and levees, has been shown to produce more naturally occurring ecological conditions. For comparison, at the Salmon Creek salt marsh restoration, low marsh conditions were fully developed after about 8 years (Frenkel 1995).

Permits and Best Management Practices
Project work, including the removal of levees, soil, and plants and the placement of materials within ditches and existing wetlands, would require state and federal permits. Permits would include a Section 404 Permit from USACE, a Section 401 Water Quality Certification through ODEQ, and a removal/fill permit from Oregon Department of State Lands (ODSL). Although the project would fill some wetland areas, the project purpose is wetland restoration, and the amount of wetland restored would be much greater than the wetland fill that would occur. Therefore, the project would be considered self-mitigating, and additional wetland mitigation measures would not be required. The County and POTB would develop a maintenance and monitoring plan as a condition of their grants that will include performance standards and adaptive management components for vegetation.

Summary of Impacts
Construction of Alternative 1 would result in moderate, local, adverse, short-term (year of construction) impacts on freshwater wetlands that would not be significant following restoration.

In addition, as noted above, these wetlands consist primarily of low quality pasture wetlands, which would reduce the intensity of the adverse impact.

During the transition period (1 to 10 years following construction), there would be major shifts in the wetland types present in the project area as freshwater wetland types are replaced by estuarine wetland types. However, because the net effect of Alternative 1 would be to increase the acreage of wetlands and to restore tidal wetlands, which provide greater functional values along the edge of the bay, these effects would be beneficial.

In the long term (10 to 50 years), restoration to a tidal wetland system would be a major local and regional benefit as lowland wetland and estuarine habitats have to a large degree been lost or degraded along the Oregon Coast. Restoration of these tidal wetlands would represent a major benefit by providing habitat for fish and wildlife species (see Section 4.6.2), including federally listed threatened or endangered species (see Section 4.6.3), and improving water quality (see Section 4.5.4) and floodplain function (see Section 4.5.1).

4.5.2.3.3 Alternative 2: Hall Slough Alternative

Construction

Alternative 2 would result in temporary, construction-related impacts to the existing environment during construction, including ground disturbance, vegetation removal, and heavy equipment operation in wetlands and adjacent to waterways. Only a portion of the Hall Slough Alternative project area is within wetlands. The NWI mapping shows the downstream portions to be likely wetlands (**Figure 4.5-9**), but the vegetation mapping based on information from Brophy (2014a, and 2014b) shows the majority of the project area is upland pasture or hayfield (**Figure 4.6-1**).

New setback levees constructed in wetland areas would disturb those wetlands and their associated vegetation (predominantly non-native pasture grasses). Construction of these levees would be regulated as a fill and would require state and federal permits.

Transition Period

The Hall Slough Alternative would reconnect Hall Slough to the Wilson River, deepen the channel to maintain a positive slope to the bay, and be tidally active throughout its length. It is expected tidal wetlands would form in the area between the setback levee and the new, widened channel. The County and POTB would develop a maintenance and monitoring plan as a condition of their grants that will include performance standards and adaptive management components for vegetation.

Long Term

The Hall Slough Alternative would allow for the restoration of up to 90 acres of riparian flow-through and tidal wetlands between the new setback levees along the Hall Slough channel. This assumes the entire area within the new setback levees becomes wetland, but because the upper end of Hall Slough is currently not wetland, it may not become wetland with the proposed widening and deepening of the slough. Therefore, the expected acreage of restored wetland under this alternative would be expected to be less than the 90 acres within the levees. The wetlands inside the new setback levees would have improved functions as they would be reconnected to the floodplain and to tidal influences, and there would be a net beneficial effect on wetlands. At the upper end of Hall Slough, approximately 0.7 miles of new levees would be constructed; however, there do not appear to be any wetlands in this area (**Figure 4.5-9**).

Over the long term, non-native and invasive plant species currently in the wetlands likely would increase as a result of seed transported by floodwaters and because agricultural operations would be phased out on the 392 acres in County ownership (of which approximately 152 acres are in current agricultural production), which would be a minor impact.

The removal of levees would balance against the construction of new setback levees to result in no net loss of wetlands. In addition, the restored areas would have greater functions because they would be connected to the slough and would be protected from disturbances from agricultural practices. The alternative would be self-mitigating with respect to potential impacts on wetlands. The long-term effect would be moderate, local, and beneficial.

Summary of Impacts

Construction impacts of Alternative 2 on wetlands would be minor, local, short term, and less than significant as most of the wetland areas are currently highly modified pasture areas. Transition-period effects of Alternative 2 on wetlands would also be minor, local, and less than significant as wetland areas would reform in the space between the new setback levees and the channel, and these areas would be protected from agricultural disturbances. Long-term impacts of Alternative 2 on wetlands would be moderately beneficial, providing for the restoration of up to 90 acres of tidal wetland.

4.5.2.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction

Alternative 3 would result in moderate, temporary, construction-related impacts to the existing environment during construction and tidal marsh restoration activities, including ground disturbance, vegetation removal, heavy equipment operation in wetlands and adjacent to waterways, and site stabilization. Construction of approximately 1.6 miles of new setback levees would result in detrimental impacts to existing wetlands but would result in a shorter length of levee overall (a total reduction of 7.2 miles of levee). Construction of the new levees and placement of fill within ditches and across the project area would be considered a fill under state and federal regulations and would require state and federal permits. Required permits would be the same as those described for the Proposed Action. This alternative would also be considered self-mitigating as it would be designed so that the wetlands on site would restore to estuarine communities. Impacts would not be significant following restoration of tidal wetlands, which would result in a net increase in total wetland area and function.

Transition Period

Similar to the Proposed Action, the transition from predominantly low quality pasture wetlands to an estuarine system would result in major modification of existing wetlands, leading to a shift in species composition in the study area. In the short term, the study area may have a greater proportion of opportunistic, non-native plant species or native colonizers than is typical of the reference wetland. Transition-period impacts would be major, local, and adverse for freshwater wetlands, but would not be significant because there would be a net increase in wetland acreage and function. The County and POTB would develop a maintenance and monitoring plan and adaptive management components as a condition of their grants that will include performance standards for vegetation.

Long Term

Long-term impacts associated with Alternative 3 would be similar to those associated with the Proposed Action; however, Alternative 3 would result in the restoration of more tidal wetlands, potentially restoring 568 acres of wetland, representing a net increase in total wetlands and an increase in wetland functions within the project area.

Overall, Alternative 3 would result in increased wetland habitat area and complexity, providing a mix of priority ecological benefits, including development of low and high tidal marsh and forested tidal wetland vegetation communities (Tillamook County 2013). Although there would be major changes in the wetland communities in the project area, no significant adverse impacts would be anticipated because wetland types would transition naturally from predominantly low functioning pasture wetlands to tidal wetlands that provide greater functions along the edge of the bay and there would be a net increase in wetland acreage.

Summary of Impacts

The effects of construction of Alternative 3 on freshwater wetlands would be moderate, local, adverse, and short term. Impacts would not be significant following restoration. As noted above, these wetlands consist primarily of low quality pasture wetlands, which would reduce the intensity of the adverse impact. During the transition period, there would be major shifts in the wetland types present in the project area as freshwater wetland types are replaced by estuarine wetland types. As with the Proposed Action, transition-period impacts would be major, local, and adverse for freshwater wetlands, but would not be considered a significant impact because there would be a net increase in wetland area and function. Alternative 3 would provide for the restoration of approximately 568 acres of tidal wetland. Existing wetlands would remain but would shift from freshwater to tidal wetlands. Restoration to a tidal wetland system would be a significant local and regional benefit as lowland wetland and estuarine habitats have to a large degree been largely lost or degraded along the Oregon Coast. Restoration of these tidal wetlands would represent a major benefit by providing habitat for fish and wildlife species (see Section 4.6.2), including federally listed threatened or endangered species (see Section 4.6.3), and improving water quality (see Section 4.5.4) and floodplain function (see Section 4.5.1).

4.5.3 Hydrology

This section contains a discussion of surface water issues, including an evaluation of potential effects to river morphology and structure from the proposed alternatives. As the lead agency, FEMA identified the need to perform an independent review of the flood model development, applications, assumptions, and uncertainties, and ultimately, the overall suitability of the modeling work to-date to prepare the EIS. The peer review of the hydraulic modeling completed for Alternative 1 further supports the impacts analysis. Appendix E contains the hydraulic modeling peer review.

4.5.3.1 Methodology

To determine potential impacts on surface waters, the existing data on surface water resources, drainage patterns, and water supply were reviewed. Aerial photographs were used to help pinpoint potential sensitive areas. A general field reconnaissance was conducted to evaluate existing conditions in the study area.

A peer review of the hydraulic modeling completed for Alternative 1 was completed following these steps:

- Literature Review
- Site Visit
- Workshop and Agency Coordination
- Risk and Uncertainty Evaluation
- Hydrology Evaluation
- Hydraulic Evaluation
- Review of Related Studies

4.5.3.2 Affected Environment

Tillamook Bay is a shallow estuary with a complex system of tidal channels and broad inter-tidal mudflats. The estuary receives riverine input from five rivers, all with headwaters in the Coast Range. As described in Section 1.1, the Tillamook Bay watershed contains five principal rivers: the Wilson, Trask, Tillamook, Kilchis, and Miami (**Figure 1-2**). The Wilson and Trask rivers drain the largest areas and contribute to the majority of flooding in the region. The Tillamook River has the lowest gradient compared to the other principal rivers, and its watershed is located mainly along the coastal foothills. The Tillamook River contributes the least to flooding and erosion problems in the region (USACE 2005).

Hydraulic conditions in the Tillamook Bay system in the vicinity of the study area are complex, multi-dimensional, and stage-dependent to a large extent. The levee between the Trask River and the overbank area of the SFC study area overtops during relatively small flood events (approximately the 5-year frequency), resulting in a lateral exchange of flow between the two sides of the levee. The protected side also has potential to fill with water from upstream sources and spill into the river. The tide gates and surrounding levee embankment at the western end of the SFC project area are also overtopped at approximately the 5-year recurrence flood event. Although the exchange of flows between the western study area, slough channels, and main river channels occurs over a range of flow conditions, including frequent, small-scale “nuisance” floods, woody debris and heavy vegetation in the slough side channels affects the efficiency of flow movements. **Figure 4.5-10** and **Figure 4.5-11** show existing conditions along the Trask River and Blind Slough, respectively.

4.5.3.3 Hydraulic Modeling of the Tillamook Bay Area

Hydraulic modeling of the Tillamook Bay area has been ongoing since the late 1960s. Each modeling effort built upon previous work, and it continues to be refined as the project definition has evolved.

Figure 4.5-10. Levee Separating Trask River from Floodplain

4.5.3.3.1 Early Modeling (1960s-1970s)

USACE performed hydraulic modeling of the Tillamook area in the late 1960s and early 1970s to develop the 1978 FEMA Flood Insurance Report for Tillamook County. The one-dimensional steady-state model, HEC-2, used topographic and cross-sectional data gathered in 1965. Model results showed that because all the rivers of Tillamook Bay are tidally influenced, an unsteady flow model of the rivers would more accurately describe flood behavior in the Tillamook area.

4.5.3.3.2 USACE General Investigation Feasibility Study (1997-2005)

From 1997 through 2005, USACE performed a General Investigation Feasibility Study, which included hydraulic model development for the Tillamook Bay and estuary to help identify possible solutions to reduce flood damage.

Figure 4.5-11. Typical Slough

MIKE11 Model (1998-2002)

USACE developed a hydraulic model using MIKE11 of the combined Tillamook, Trask, and Wilson rivers as well as the Miami and Kilchis rivers systems. MIKE11 is a one-dimensional, unsteady flow modeling program that uses river cross-sections, structural geometries, and geographical networks to simulate flow and water levels. The MIKE11 model included only the major culverts in the analysis, and many elevations were estimated based on data available at the time. Data from the November 1999 flood event were used to simulate the effects of several flood control measures, including channel dredging, levee removal, and levee setbacks. The alternatives were designed only to a minimal level to evaluate possible benefits of each potential flood control measure. If it appeared that flood benefits did exist, then the alternative was kept in the process and further refined. If flood benefits were minimal or did not exist, then the alternative was dropped from further study. The MIKE11 model was completed in December 2001, and preliminary analysis results were presented in March 2002.

The initial MIKE11 model results described above showed that the greatest flood damage reduction benefits could be achieved by increasing the capacity of the existing floodways or by providing additional channels.

The Hall Slough Alternative was one of the initial alternatives modeled using MIKE11. Initial modeling results using the November 1999 flood event showed the modified slough could carry approximately 1,000 cfs of floodwater that would have previously flooded Highway 101. This alternative also lowered the duration of flooding on Highway 101 by approximately 4 hours. Although this alternative would not control flooding for floods greater than the frequent, small-scale "nuisance" floods, it would help to control the common annual flooding in the Highway 101 area. Based on these results, the Hall Slough Alternative was carried forward for further study.

Conversion from MIKE11 Model to HEC-RAS Model (2003)

USACE converted the MIKE11 model to a HEC-RAS model in 2003. HEC-RAS is more sophisticated than MIKE11 and more capable of addressing the complex nature of flooding in the Tillamook area.

ADvanced CIRCulation Model

USACE used a two-dimensional, finite element model, ADvanced CIRCulation (ADCIRC), to evaluate several preliminary alternatives for decreasing the stage of multiple rivers that discharge into the Tillamook Bay estuary. The objective of the ADCIRC model was to determine whether channel dredging could reduce water elevations in the backbay area of the estuary during high river flow events. The model results showed that estuary-based alternatives were not effective for reducing the flood stage at the river mouths during high riverine flow events.

This analysis showed it would be more effective to (partially) restore the floodway for each of the major coastal rivers discharging into the bay. The model results showed inland flooding near the City of Tillamook was not related to conveyance issues within Tillamook Bay. The only feasible way to reduce inland riverine flooding would be to change the hydraulic characteristics of the rivers and associated floodways.

4.5.3.3.3 HEC-RAS Modeling (2008-2015)

In December 2008, NHC, under contract with Tillamook County, took over hydraulic modeling of the SFC project area. Between 2008 and 2011, enhancements to the HEC-RAS model consisted of developing new floodplain cross sections using light detection and ranging (LiDAR) data acquired in 2008. In addition to topographic updates, some reaches were adjusted to better match actual flood flow paths. The model was also extended down the bay to Garibaldi. The model results showed the system is insensitive to tidal conditions upstream of the junction of Hoquarten Slough and the Trask River, confirming results of the ADCIRC modeling.

Model calibration, field inspection, and high water marks all point to the importance of levees in controlling flood patterns in the Wilson River floodplain, especially during smaller floods. Unfortunately, levees have higher levels of uncertainty within the model due to two factors. First, the actual elevations of the levees are less certain than most other topographic features. Canopy cover, brush, and the small size of many levees mean both photogrammetric and LiDAR based aerial mapping can have considerable errors. This uncertainty was mitigated by additional ground surveys to update the model input data. Second, levee failures are common in virtually all floods. These failures cannot be modeled, but they can change the flow distribution and flood levels in portions of the valley. Such levee failures may cause large localized increases in flood levels not reflected in the modeling, especially in small floods.

Due to the uncertainty related to levee failure, model calibration was focused on ensuring the model reasonably simulated the full range of floods rather than trying to exactly match one specific event. In general, model calibration against observed data within the main Wilson River channel was consistent over a range of floods and less so in the overbank areas. The Wilson River in the vicinity of the Highway 101 bridge is one exception. Modelers were unable to calibrate the model at that location using the normal range of parameters for a river channel of its form. The observed high water marks and witness accounts show the bridge creates a large backwater effect that the model had difficulty in replicating.

The County and POTB performed additional hydraulic modeling of the current conditions in 2013 and 2014 using the HEC-RAS model. The HEC-RAS model was also used as the primary technical tool in hydraulic evaluation of the No Action, Southern Flow Corridor – Landowner Preferred, and Initial alternatives.

4.5.3.3.4 Peer Review of HEC-RAS Model (2014-2015)

FEMA performed an independent review of the history of flood model development, applications, assumptions, and uncertainties, and ultimately, the overall suitability of the modeling work to date to prepare the EIS. Appendix E contains the complete peer review results.

Uncertainty and Risk

The study area is located within an unusually complex hydrologic and hydraulic system. Even with substantial effort to collect data and construct analytical and simulation tools that represent that system, uncertainty exists about how it performs under current conditions and how it may perform under the EIS alternatives.

Uncertainty in the model results creates uncertainty for decision making by limiting the predictive ability of simulation models to compare alternative actions. The areas of greatest uncertainty are related to uncertainty regarding expected flood discharge timing and distribution of flows and the parameterization of roughness and other factors that affect the efficiency of water movement through the study area.

While some types of uncertainty are essentially unbounded, there are specific activities that could be taken to mitigate these risks. This generally will take two forms: (1) sensitivity analyses to properly bound the impacts of uncertainty on resulting information about alternative performance and (2) collection and application of additional primary data about discharge rates, water surface elevations, geometry, and flow paths. The peer review conducted a sensitivity analysis, and the results are summarized in this section and described in Appendix E. Additional data collection would require more intensive effort and investment to gain greater confidence in the model results and interpretation.

Hydrology Evaluation

The range of flood events considered in the HEC-RAS evaluation is sufficient for the purposes of evaluating the flood reduction benefits associated with the EIS alternatives. Using historic flood events to characterize the potential benefits of a future condition relies on the assumption that future flows would be similar to those that have occurred in the past. While this is a generally reasonable approach, it does not account for the impacts of future climate change.

The peer review found the use of gaged historic flows and the choice of specific design flows in the model are reasonable; however, the methods used to develop the synthetic flows for the ungaged rivers is relatively crude and includes expected systematic bias. Ungaged rivers are those where there were no data collected on flows; therefore, flows used in the model are estimated.

Hydraulics Evaluation

Conventional wisdom could lead to the conclusion that increasing the conveyance of the estuary would reduce flood stages at the river mouths during a high riverine flow event; however, based on the modeling results, estuary-based alternatives would not be effective at reducing the stage at the river mouths during high riverine flow events. The best method for reducing river stage and alleviate coastal flooding around Tillamook would be to (partially) restore the floodway for each of the major coastal rivers discharging into the bay.

Based on the model results, inland flooding near the City of Tillamook was found not to be related to conveyance issues within Tillamook Bay. The only feasible way to reduce inland riverine flooding from the bay would be to change to hydraulic characteristics of the rivers and associated floodways.

The sensitivity of the model to the tidal boundary condition was tested by running the 1999 (5-year) flood with the observed tides increased by 1 foot and decreased by 2 feet. Changes to maximum water surface elevations extended to the junction of Hoquarten Slough and the Trask River.

In summary, the modeling approach selected for the Tillamook model relies on commonly used methods and assumptions; however, the approach does have some limitations that should be noted. The complex hydraulics that exist in the Tillamook area are inherently multi-dimensional, and the ability of the one-dimensional HEC-RAS model to accurately simulate those processes may be limited. Model validation would be required for proof of the model's predictability.

It is important to keep in mind the modeling approach was selected with the modest goal of being able to simulate the *relative* benefits of alternative flood reduction actions but not necessarily predict the precise absolute values of peak water levels at all locations. While the confidence level in model-predicted absolute water levels is low, the confidence level in the model-predicted flood reduction benefit, relative to the existing condition, is higher. However, the model-predicted relative benefits are small, and more importantly, contain a potential margin of error that is equal to the predicted flood reduction benefits. Therefore, the results are highly uncertain. Appendix E provides additional discussion of confidence of the model results.

Conclusions

The ability of the model to assess timing of flood flows is limited by the data collected for model calibration; therefore, confidence intervals on flow estimates at a specific frequency are relatively large. This means that when estimating a flood event (e.g., 5-year flood), the expected peak flow from a tributary stream (as well as the timing and volume of the flow from the tributary stream) is uncertain and may be significantly different than modeled.

The model results can generally be described as ±1 foot but may vary locally by as much as 3 feet from the measured peak water surface at the same location. This is approximately the same magnitude as the proposed flood benefits for the action alternatives. Simply, the modeled benefits are about the same magnitude as the measured error.

4.5.3.4 Environmental Consequences

Based upon the regulatory framework established by the regulations discussed in Section 4.5.1, Section 4.5.2, and Appendix C, and using the impact scale described in **Table 4.1-1**, a qualitative evaluation to evaluate potential impacts on surface water resources was conducted and is described below for each alternative. For the purpose of this EIS, a significant adverse impact would do any of the following:

- Substantially alter the existing drainage pattern of the site or area, including the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on or off site
- Create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems

4.5.3.4.1 No Action Alternative

Construction

There would be no construction activities as part of the No Action Alternative; therefore, there would be no construction-related impacts on surface water hydrology. Long-term adverse impacts of the No Action Alternative on surface water would be major, local, and significant.

Transition Period and Long Term

Under the No Action Alternative, inputs to receiving waters would not change. The river structure and morphology would not be expected to change. Flood elevations would be expected to remain similar to past events, with variances attributable to differences in precipitation, tide elevations, and sea level rise. Although maintenance of the perimeter levees around the SFC project area might decline with the elimination of agricultural uses on the County-owned lands, deterioration of these levees would not be expected to measurably affect flood elevations over the long-term analysis horizon of 40 to 50 years. Short- term adverse impacts of the No Action Alternative on surface water would be major, local, and significant.

4.5.3.4.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Construction

Adverse construction impacts of Alternative 1 on surface water hydrology would be minor, local, and less than significant as changes would not be seen until after construction is complete.

Branches and other vegetative debris would be chipped on site and used for hog fuel access roads and brush berms. Brush berms would be used in lieu of silt fences on most of the site for sediment control during construction. Bigger limbs and tops would be used in place for temporary plank roads for construction access. These plank roads would remain post-project and would deteriorate in place.

Transition Period

The Proposed Action is designed to have a major beneficial effect on the hydrology of the SFC project area by removing levees, reconnecting the floodplain to its rivers and sloughs, and re-introducing tides to the SFC project area. The re-introduction of tidal influences would occur immediately following construction while other changes, such as the recreation of tidal channels, would take longer as they would be allowed to develop naturally. There would be a transition period while tidal channels reform and other channels adjust to the changed conditions.

Long Term

The Proposed Action would affect surface water hydrology by increasing the area influenced by the tides. The Proposed Action would allow new tidal channels to develop in the project area. Other relic tidal channels also would adjust and reform as they begin to convey tidal flows in and out of the site again. Approximately 14 miles of tidal channels are expected to reform within the project area. Existing drainage ditches in the project area would be filled, and surrounding levees would be removed. Ditches would be filled in such a way that some parts of an open ditch may be over-filled while other parts may be left as low spots to enhance topography and encourage sinuosity of the developing channel, as described in the Programmatic Restoration Opinion for Joint Ecosystem Conservation by the Services (PROJECTS) biological opinion. Blind Slough would enlarge as it would become an important flood flow channel, conveying flows both from new floodgates in the new setback levee and from the Hall Slough connector channel. Some lateral movement and change of the main river channels can also be expected where rock armoring would be removed. However, channel migration is expected to be relatively minor based on historic patterns.

Levees that would be constructed or modified under this alternative would be designed to allow river flood flows to move out to the bay while preventing high tides and coastal storm surges from getting upstream past the project area. Removal or lowering of existing levees combined with daily high tides and river flows would allow greater amounts of sediment onto the site as compared to the existing condition. Ultimately, the land would be expected to rebuild from its current subsided condition up to a high marsh elevation. Areas close to the surrounding rivers and connected tidal channels would likely rebuild more quickly while the center of the site or areas in the eastern portions where fewer levee changes would be made would receive less sediment and accrete more slowly. New floodgates would allow flood flows to be conveyed out to the main river channels and bay. Flood reduction benefits would be sustained over the design life of 40-50 years under projected sea level rise due to climate change (NHC 2011).

The tidal marsh vegetation that is expected to become established would not impede flood flows. The Proposed Action would alter the hydrologic and salinity regimes over much of the SFC project area, and it is expected there will be little woody vegetation in the future. The large woody debris that would be placed on site during construction for habitat benefits would not affect the modeled flood reduction results nor would it impede flood flows.

Summary of Effects

Adverse construction impacts of Alternative 1 on surface water hydrology would be minor, local, and less than significant as changes would not be seen until after construction is complete. Over the short term, there would be a transition period where major, local, beneficial changes would occur in the hydrology of the project area. Over the long-term, Alternative 1 would have major beneficial effects on surface water hydrology in the Tillamook Valley. Long-term effects on flood elevations would be beneficial.

4.5.3.4.3 Alternative 2: Hall Slough Alternative

Construction and Transition Period

Adverse construction impacts of Alternative 2 on surface water hydrology would be moderate and local as a substantial amount of dredging would be needed to complete the initial widening and deepening of the channel. This would be a significant and unavoidable impact on hydrology. Beneficial effects on hydrology would occur immediately after construction was complete. Until the channel is revegetated, sediment transport is likely to occur, which would result in a minor but less than significant impact on hydrology during the transition period.

Long Term

The Hall Slough Alternative would affect surface water hydrology by connecting the upstream end of Hall Slough to the Wilson River. Approximately 1.9 miles of the channel would be widened and deepened to maintain a positive slope to the bay and to consistently pass flows of 1,000 cfs. In addition, the setback of the levees would increase the amount of floodplain area directly connected to the slough by approximately 90 acres. There would be no other changes in hydrology within the study area.

The Hall Slough Alternative would have minor beneficial effects on flooding in the Tillamook Valley. The reconnection of Hall Slough with the Wilson River, along with the widening and deepening of the channel, would be expected to control flooding for frequent, small-scale "nuisance" floods that flow across Highway 101 between Hall and Dougherty sloughs. These floods are equivalent to an annual or 1-to 2-year flood event. Alternative 2 would have little to no effect on larger flood events.

Following construction, the channel likely would need to be periodically dredged to maintain the design channel depth and beneficial effects of implementation of the alternative. Based on the history of dredging in the Tillamook basin, maintenance dredging might be expected to be needed every 2 to 5 years. The frequency would depend on how quickly sediment accumulates in the channel, with the goal being to maintain the designed channel capacity.

Summary of Effects

Construction impacts of Alternative 2 on surface water hydrology would be moderate and local as a substantial amount of dredging would be needed to complete the initial widening and deepening of the channel. This would be a significant and unavoidable effect on hydrology. Transition-period impacts would be minor and local but less than significant. Beneficial effects on hydrology would occur immediately after construction was complete, but periodic maintenance dredging would be required to maintain the beneficial effects. Long-term impacts of Alternative 2 on surface water hydrology would be beneficial and regional but minor.

4.5.3.4.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction and Transition Period

Adverse construction impacts of Alternative 3 on surface water hydrology would be minor, local, and less than significant as changes would not be seen until after construction is complete. There would be a transition period where major changes would occur in the hydrology of the project area. These effects would be beneficial.

Long Term

Alternative 3 would affect surface water hydrology through changes similar to those described for the Proposed Action. Potential impacts on water flows, tidal influence, and channel morphology would be similar to the Proposed Action. Under Alternative 3, an additional 46 acres would be restored to tidal influences and potentially develop additional tidal channels as compared to the Proposed Action. Lands re-exposed to the daily tides would be expected to capture sediments and build back up to elevations similar to those of adjacent undiked lands. Alternative 3 would result in approximately 568 acres of restored wetlands and over 14 miles of restored side channels.

Summary of Effects

Adverse construction impacts of Alternative 3 on surface water hydrology would be minor, local, and less than significant as changes would not be seen until after construction is complete. There would be a transition period where major changes would occur in the hydrology of the project area. These effects would be beneficial. Over the long-term, Alternative 3 would have major beneficial effects on surface water hydrology in the Tillamook Valley. Long-term effects on flood elevations would be beneficial.

4.5.4 Water Quality

This section contains a discussion of surface water quality, including impacts from the proposed alternatives.

4.5.4.1 Methodology

To determine potential impacts on surface water, existing water quality data and literature, Total Maximum Daily Loads (TMDLs), and NPDES permits were reviewed. The Institute for Applied Ecology and the Confederated Tribes of Siletz Indians performed an Effectiveness Monitoring Program in 2014, which included collection of water quality data. Data collected from the Effectiveness Monitoring Program informed this analysis.

4.5.4.2 Affected Environment

Under Section 303(d) of the Clean Water Act, ODEQ is required to develop a list of the surface waters in the state that do not meet water quality standards developed for protection of beneficial uses. Water bodies that are listed as impaired must have TMDLs developed for each pollutant for which that waterbody is “listed” (ODEQ 2001). ODEQ has listed the Tillamook Bay watershed as water quality limited for temperature and bacteria. ODEQ developed a TMDL for these two pollutants in the Tillamook Bay Watershed in 2001. TMDLs define the maximum amount of controllable impacts a waterbody can accept and still assure that designated beneficial uses are being adequately protected. A total of 20 waterbodies in the Tillamook Bay watershed are listed for bacteria and temperature, 15 stream segments are listed for bacteria, and 12 stream segments are listed for temperature.

In addition, several rivers and streams in the study area are on the Oregon 303(d) list of impaired waterways (summarized in **Table 4.5-4**).

Table 4.5-4: 303(d) Listed Streams within 2 miles of the SFC Project Area

Constituents of Concern [1]	Dougherty Slough	Hall Slough	Hathaway Slough	Hoquarten Slough	Kilchis River	Rice Creek	Tillamook Bay	Tillamook River	Trask River	Vaughn Creek	Wilson River
Alkalinity	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y
Ammonia	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y
Antimony							Y		Y		
Arsenic (tri)							Y		Y		
Barium							Y		Y		
Beryllium							Y		Y		
Biological Criteria					Y			Y			
Cadmium							Y		Y		
Chloride					Y	Y		Y	Y		Y
Chlorophyll a	Y	Y		Y	Y		Y	Y	Y	Y	Y
Chromium (hex)							Y		Y		
Copper							Y		Y		
Dissolved Oxygen	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y
E. Coli				Y	Y			Y	Y		Y
Fecal Coliform	Y	Y		Y	Y		Y	Y	Y	Y	Y
Flow Modification					Y						Y
Habitat Modification					Y			Y	Y		Y
Iron					Y		Y		Y		Y
Lead							Y		Y		
Manganese					Y		Y		Y		Y
Nickel							Y		Y		
Nutrients					Y		Y	Y	Y	Y	Y
pH	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Phosphate-Phosphorus				Y	Y			Y	Y		Y
Sedimentation					Y		Y	Y	Y		Y
Selenium							Y		Y		
Silver							Y		Y		
Temperature					Y			Y	Y		Y
Thallium							Y		Y		
Zinc							Y		Y		

Source: ODEQ 2012

Note: 1 - "Y" indicates the stream is on the 303(d) list for the constituent of concern.

The 2010 Tillamook Bay Watershed Health Report (TEP 2010) calls out five pollutants of concern in the Tillamook Bay Watershed: temperature, bacteria, dissolved oxygen, toxic substances (including heavy metals), and sediment. In general, bacteria levels and sedimentation in the watershed are improving, and there are signs of healthy influences on toxin levels. Stream temperatures and dissolved oxygen concentrations are shown as needing improvement (TEP 2010). Sediment and sedimentation is discussed in greater detail in Section 4.7.1.2.

USGS monitors surface water quality parameters at two locations east of the study area:

- Wilson River near Tillamook, OR (14301500) – east of the City of Tillamook
- Trask River above Cedar Creek, near Tillamook, OR (14302480) – southeast of the City of Tillamook

Water quality is influenced by pollution from nonpoint sources and point sources. Non-point sources are land uses that contribute pollutants from diffuse areas. These sources include forestry, agriculture, and rural residential and urban development. Point sources discharge directly to waterbodies, and their contributions are controlled through limits set in NPDES permits. These sources include sewage treatment plants and industrial sources such as the Tillamook Creamery (ODEQ 2001).

4.5.4.2.1 Temperature

Temperature in the rivers and sloughs can have an adverse effect on the migration, rearing, and spawning of salmonid fish if it exceeds 64°F for migration and rearing or 55°F for spawning in the summer (ODEQ 2001). Loss of riparian vegetation that shades river channels or sedimentation that decreases water depths can have an adverse effect on temperature.

The Confederated Tribes of Siletz Indians (CTSI) sampled water temperature at eight locations throughout the study area from March through August 2014. All but one sample exceeded 64°F during July and August. Samples collected in the Blind Slough tributary did not exceed 64°F during the entire sample period. Samples collected from Blind Slough inside the tide gate and where Nolan Slough meets the Trask River exceeded 64°F during May and June, respectively.

The recent CTSI data support data previously presented in the 2001 Tillamook Bay Watershed TMDL report, which states that surface water temperatures commonly exceed 64°F in the mainstems of all the rivers and many of their tributaries in the summer months (ODEQ 2001). Temperatures increase with distance from the headwaters of each river and show the influence of warm or cold water from various tributaries. ODEQ has determined the source of stream heating derives from the combined effects of ongoing and past removal of riparian vegetation and the subsequent widening of streams.

USGS data from 2011 through 2014 show surface water temperatures in the Wilson and Trask rivers ranging from the upper 30s to the low 70s (°F) throughout the year.

Within the Tillamook Bay Watershed, eight streams are on the 303(d) list for temperature. The beneficial use that is affected by temperature is cold water aquatic life, including anadromous fish passage, salmonid fish spawning, salmonid fish rearing, and resident fish and aquatic life.

Warm point source discharges in the Tillamook Bay watershed are sources of stream heating. The Tillamook Bay TMDL identifies eight NPDES permitted discharges identified as temperature-related point sources in the watershed, including six sewage treatment plants, a campground, and the Tillamook Creamery. Discharge temperature data are limited for many of the facilities, and discharge flow rates are generally very low. Discharge temperatures are typical of small sewage treatment plants (~70°F); however, the Tillamook Creamery has a warm effluent temperature ranging as high as 92°F.

4.5.4.2.2 Bacteria

As described in Section 4.5.1, the majority of farms in the Tillamook valley have been dairy farms since the area was first developed. Since the early 1900s, livestock manure has been used as fertilizer; artificial fertilizers have not been widely used. By 1989, there were approximately 19,000 cows within the Tillamook Bay pasture lands, which produced 275,000 tons of manure. Fecal bacteria contamination of bay waters during heavy rainfalls was first identified in 1969 when routine water quality monitoring was begun. Through the implementation of agricultural BMPs in the 1980s, water quality monitoring showed a 40 to 50 percent reduction in mean fecal coliform (Coulton et al. 1996).

The Tillamook Bay drainage basin has four domestic wastewater treatment plants identified as bacteria-related point sources that discharge to the bay or rivers (ODEQ 2001). The Tillamook County Creamery Association operates a combined domestic and industrial treatment plant that discharges to the Wilson River and is also identified as a bacteria-related point source (ODEQ 2001).

The water quality standard for bacteria in shellfish is a fecal coliform median concentration of 14 organisms per 100 milliliters (mL), with not more than 10 percent of samples exceeding 43 organisms per 100 mL. Per OAR 340-41-204 (2)(e)(A)(i), the standard for recreational contact in water is a 30-day log mean of 126 *E. coli* organisms per 100 mL, based on a minimum of five samples; no single sample shall exceed 406 *E. coli* organisms per 100 mL.

Within the Tillamook Bay watershed, nine streams, the Tillamook and Netarts bays, and the Pacific Ocean are on the 303(d) list for fecal coliform or *E. coli* (ODEQ 2012). These bacteria are also the source of the impairment of bay waters, which support commercial shellfish harvesting. Shellfish harvesting is dependent on waters with minimal concentrations of fecal bacteria, and the bay is currently restricted from commercial shellfish harvesting whenever flow in the Wilson River exceeds 2,500 cfs due to the risk of bacterial contamination (ODEQ 2001). The beneficial uses that are affected by bacteria are water contact recreation and shellfish growing and harvest.

Manure is generally used as fertilizer in the study area rather than chemical fertilizers, which can be a source of bacteria to surface waters. Other sources of bacteria in the watershed include rural and urban residential development (homes in some areas have failing septic systems), urban stormwater runoff, livestock management and other agricultural activities, and several wastewater treatment plants that discharge either to the rivers or the bay (ODEQ 2001).

Septic systems are common throughout the Tillamook area outside of the City of Tillamook. Their efficacy depends partly on soil type. The cumulative impacts from septic systems can result in increased nutrient loading to surface waters. Two active septic systems are located within the SFC study area (Jones and Diamond F properties).

Upstream of the study area, bacteria concentrations regularly exceed standards; recent improvements have been made by the City of Tillamook to their stormwater infrastructure that may not be fully expressed in the existing data (Johnson 2015).

The BMPs implemented along the Wilson River (such as riparian habitat enhancement, livestock exclusion, wet and dry manure storage, off-channel livestock watering stations, and buried manure mainlines) have resulted in the Wilson River meeting recreational use standards for *E. coli* since 2005. Bacteria concentrations in the study area are generally improving (TEP 2010).

TEP data show current bacteria levels just outside the study area range from approximately 20 counts/100 mL up to the low 70s counts/100 mL. Levels are higher along the Kilchis River and further upstream along the Trask River.

4.5.4.2.3 Dissolved Oxygen

At low dissolved oxygen (DO) levels, aquatic organisms can be impaired or die. The ODEQ water quality standard in estuaries is 6.5 milligrams per liter (mg/L). This standard is based on the minimum level required to support aquatic life. DO levels are affected by temperature, algae growth, nutrients, flow, and other factors. Dougherty, Hoquarten, Hall, and Hathaway sloughs are water quality limited for DO. TEP data indicate DO regularly drops below the standard during spring, summer, and fall. Hoquarten and Hall sloughs are most frequently impaired. The lower Trask River, near the confluence of Hoquarten and Dougherty sloughs, maintains adequate DO levels (TEP 2010).

Data collected by CTSI between March and August 2014 indicate dissolved oxygen and salinity generally trended downward between April and August except for two sampling locations: Blind Slough tributary and in the northwest portion of the drainage ditch in the wetland restoration area. DO levels ranged between 3.8 and 13.6 mg/L.

USGS data for DO range from approximately 6 mg/L to 13 mg/L. DO levels are lowest during the late summer.

4.5.4.2.4 Salinity

CTSI calculated salinity based on conductivity and temperature; salinity trends followed the same trends as conductivity and temperature. At no time did salinity exceed 0.013 Practical Salinity Units/Parts Per Thousand at any of the sampling locations during the low slack period.

Saltwater intrusion is likely to occur in areas that are surrounded on most sides by seawater; for this reason, saltwater intrusion is unlikely to be of concern in the study area (Oregon Coastal Zone Management Association, Inc. 1977). In addition, contribution of fresh water to Tillamook Bay during the winter reduces saltwater intrusion (TBNEP 1998a).

4.5.4.2.5 Toxic Chemicals

Toxic chemicals are not a substantial water quality issue in the study area (TEP 2010). Runoff from roads and parking lots, particularly along the Highway 101 corridor and near the City of Tillamook, can contribute hydrocarbons, metals, and pesticides and herbicides from residential use and road maintenance to surface waters. Minimal pesticides and herbicides are used on the hay production and dairy cow pastures in the study area. A trend in the application of fertilizers in the County from 1954 to 1992 shows peak usage in the mid-1960s, a decline to the late 1980s, and an increase again in the 1990s (Coulton et al. 1996). The agricultural lease on the County property within the SFC study area is currently operated as an organic farm. Mercury is not a contaminant of concern in the study area (ODEQ 2011). The contaminated soils at the Sadri property (described in detail in Section 4.7.5) include some areas that are above clean up levels for petroleum hydrocarbons (heavy oil), polynuclear aromatic hydrocarbons (PAHs), and metals (primarily cadmium and lead).

4.5.4.3 Environmental Consequences

Based upon the regulatory framework established by the regulations discussed in Section 4.5.4, and using the impact scale described in **Table 4.1-1**, qualitative evaluation of potential impacts on water quality of each alternative was conducted. For the purpose of this EIS, a significant adverse impact would do any of the following during construction, shortly after construction (approximately 2 years), and/or permanently:

- Violate any applicable water quality standards or waste discharge requirements
- Negatively alter the baseline water quality conditions
- Provide substantial additional sources of polluted runoff

4.5.4.3.1 No Action Alternative

Construction

There would be no construction activities as part of the No Action Alternative; therefore, there would be no construction-related impacts on water quality.

Transition Period and Long Term

Under the No Action Alternative, agricultural operations (grazing and hay production) would be phased out on the 392 acres in County ownership (of which approximately 152 acres are in current agricultural production). The existing levees would not be reconfigured, and the fields would slowly transition to freshwater wetlands. The fields may transition to forested or scrub/shrub wetland, but it is unlikely the fields would transition to tidal wetlands. The area is already classified as wetland and would not become upland. The fields would no longer receive manure as fertilizer, and bacteria inputs to the water system would be reduced. There would be negligible changes on water quality conditions with respect to temperature.

Under the No Action Alternative, the contaminated materials on the Sadri property would not be remediated. Contaminated materials from the site could be picked up by floodwaters and move into area waterways where they could impact aquatic life. This potential impact would be a moderate, long-term, adverse impact that would be significant.

Transition-period and long-term effects of the No Action Alternative on water quality would be beneficial, minor, and local because the study area would no longer be used for agricultural purposes. Because the contaminated materials on the Sadri property would not be remediated, the No Action Alternative would result in potential moderate, local, long-term adverse water quality impacts, which would be significant.

4.5.4.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Construction

Construction of the Proposed Action would disturb soils, which could increase erosion potential during heavy rains, floods, or daily tides once the surrounding levees are lowered. Construction of the Proposed Action would temporarily increase turbidity through scour and soil erosion until the streambanks and channels stabilize during the construction and transition period. Potential impacts would be moderate, local, and significant without mitigation. To minimize impacts to water quality, contractors would work in dry conditions as much as possible. Filter socks would be placed at the top, on the face, and at the toe of slopes. All exposed surfaces on levees would be hydroseeded to stabilize the new levees quickly. As described in Section 3.4.2, once the levees are breached, final excavation would require working within tide cycles, working back out of the project site without the benefit of loop haul roads, and more complex sediment control measures. With the implementation of the sediment-related BMPs discussed in Section 6, adverse water quality impacts during construction would be minor, local, and less than significant.

Transition Period

In the short term, there would be a moderate but less than significant impact on water quality from the inundation of farmland on which manure has historically been applied as fertilizer since the early 1900s. Near the study area, this could lead to decreased dissolved oxygen concentrations as a result of accelerated biological processes from the nutrient loading. However, water quality in the study area would quickly return to levels found within normal tidal wetland areas. Export of phosphorous, nitrogen, and organic matter would be restored to levels seen within adjacent wetland areas, likely within several years. Dissolved oxygen concentrations would also be restored to local levels within several years. The water quality function of the restored tidal marsh would be greater than the existing condition as the site would function to filter and remove pollutants such as nitrogen and phosphorus from the water through productive vegetation growth and sediment accretion.

The disposal of excess fill material over large portions of the project area that would be inundated with the daily tides could result in the mobilization of silts and sands from the fill material. This could result in moderate, localized, adverse water quality impacts from turbidity and sedimentation in the adjacent rivers and the bay. This effect would be expected to decrease as the project area becomes more vegetated, so this would be a short-term impact, but it could occur for up to 4 years following construction (Section 4.5.2). This adverse impact could be significant for a short period. It is also possible that the fill material would only be mobilized during unusual storm events or floods during the transition period. During these types of events there is a significant amount of sediment carried by flood waters and the inputs from the project area would be a minor addition.

Long Term

The Proposed Action would restore approximately 522 acres to tidal wetlands. Large areas would no longer be used for hay production or pasture, which would reduce the amount of nutrients in the water, and overall, water quality would be expected to improve. The restored wetlands would provide additional filter mechanisms for run-off and would contribute to improved water quality. Benefits would be moderate.

Once the streambanks and levees have stabilized following construction, water quality in the Bay and adjacent channels would improve. The project area would no longer be used for agricultural purposes, and bacteria inputs to the surface water in the project area would be expected to decrease. Surface water quality benefits would be moderate.

Under the Proposed Action, the contamination at the Sadri property would be remediated as described in Section 4.7.5. This would mitigate this potential adverse impact and be a long-term, moderate, beneficial effect of the project.

FEMA conducted an evaluation to determine the potential for methylmercury (MeHg) formation following restoration of tidal marsh under the project alternatives. Restoration of farmland back to tidal wetlands in areas with elevated mercury sediment has been shown to increase the accumulation of mercury in the local aquatic food web (see evaluation in Appendix F). Based on data from previous investigations, the concentrations of total mercury in Tillamook Bay sediments are typical of those found in other basins that have not been impacted by mining or other mercury sources. In addition, mercury concentrations in Tillamook Bay sediments are lower than those found in other parts of the Oregon Coast Range; therefore, restoration of tidal wetlands under the Proposed Action would not be expected to impact water quality by the formation of MeHg.

Based on a similar tidal restoration project in the Nisqually River delta, Washington, it is likely tidal flow restoration could increase surface water temperatures. Water quality studies as part of the a tidal restoration project in the Nisqually River delta showed water temperatures were approximately 2°F warmer in the restored tidal channels than in the reference channels (David et al. 2014). David and others (2014) attributed the warmer temperatures to the channels' sensitivity to air temperature and solar irradiance because of greater channel surface area. Under the Proposed Action the main channels are not anticipated to be wider; however, new side channels will form, increasing the water surface area overall. Based on the results of the Nisqually River restoration project and the additional surface area, the water temperature in the project area is expected to increase minimally; impacts would be minor, adverse, and less than significant. Water temperature may remain elevated because the area would not be revegetated with woody vegetation, which could shade channels.

Summary of Effects

Adverse construction and transition period impacts on water quality from turbidity in surface waters under Alternative 1 would be moderate and local. With the implementation of BMPs and mitigation measures described in Section 6, these potential impacts would be reduced, but significant adverse impacts could remain during the transition period. Long-term water quality benefits of Alternative 1 would be moderate and regional because of the reduced agricultural uses and the restoration of wetlands.

4.5.4.3.3 Alternative 2: Hall Slough Alternative

Construction

Construction of the Hall Slough Alternative would temporarily increase turbidity through scour and soil erosion until the streambanks and channels stabilize. A number of BMPs related to soil erosion, sedimentation, and dredging practices would be implemented to minimize transport of sediment to surface waters and turbidity from dredging. These measures are described in Section

6. With the implementation of these BMPs, adverse water quality impacts during construction would be moderate, local, and less than significant.

Dredged materials from the Slough would be dewatered; provisions would be made to appropriately dewater sediments dredged from the channel. These provisions may include the use of geotextile tubes to allow water to migrate through a membrane while retaining sediments or the use of filter presses or other similar equipment to expel water while collecting solids. Solids would be stockpiled for as brief a period of time as possible, and exposed stockpiles would be covered with plastic sheeting. The dewatered solids would be used on site for the levees, and transport off site would not be needed.

Transition Period and Long Term

Following construction, the channel likely would need to be periodically dredged to maintain the design channel depth. Based on the history of dredging in the Tillamook basin, dredging might be expected to be needed every 2 to 5 years and would be conducted with a barge-mounted crane (Levesque 2010). Turbidity that would result from both the initial construction and subsequent maintenance could result in moderate, periodic reductions in water quality. Maintenance dredging would be governed by federal and state permits to protect water quality and fisheries' resources. Dredging would be required to be conducted in a manner that minimizes turbidity impacts. Temporary adverse impacts on water quality from dredging would be moderate and less than significant.

Restoration of tidal wetlands under the Hall Slough Alternative would not be expected to result in formation of MeHg, which can impact water quality. As described under the Proposed Action, the soils in the Tillamook Valley contain low levels of mercury naturally, and there are no anthropogenic sources of mercury.

The widening and removal of existing levees to construct setback levees would remove riparian vegetation that currently provides shade and moderates water temperatures in the slough; however, the setback levees would allow up to 90 acres of additional space for riparian and wetland vegetation to become reestablished along the banks. This extra vegetation would, in the long term, provide temperature-moderating shade and filter nutrients from stormwater runoff. Woody vegetation, such as willow, alder, and cottonwood, would grow back and within approximately 15 years would be dense enough for benefits to be realized.

Under Alternative 2, much of the SFC study area would no longer be used for agriculture. Agricultural operations (grazing and hay production) would be phased out on the 392 acres in County ownership. The existing levees would remain in place, and the fields would slowly transition to freshwater wetlands. The fields may transition to forested or scrub/shrub wetlands, but it is unlikely that the fields would transition to tidal wetlands. The area is already classified as wetland and would not become upland. The fields would no longer receive manure as fertilizer, and bacteria inputs to the water system would be reduced.

Under Alternative 2, the contaminated materials on the Sadri property would not be remediated. There would be a moderate long-term risk for contaminated materials from the site to be picked up by floodwaters and moved into area waterways where they could impact aquatic life. As described in Section 4.5.4.3.1, this would be a significant impact on water quality.

Summary of Effects

Adverse construction-related impacts of Alternative 2 on water quality would be moderate, local, and less than significant. Alternative 2 would require periodic maintenance dredging for the long term that would have moderate, temporary, adverse impacts on water quality. With implementation of BMPs and mitigation measures described in Section 6, these adverse impacts would be minor and less than significant. Because the contaminated materials on the Sadri property would not be remediated, Alternative 2 would result in moderate, local, long-term, adverse water quality impacts, which would be significant. Even with the potential adverse effects from unremediated contamination at Sadri and the intermittent, short-term impacts from maintenance dredging, the Hall Slough Alternative would have moderate, localized, beneficial effects on water quality in the long term. Transition-period and long-term beneficial effects would be localized to Hall Slough and the lower Wilson River.

4.5.4.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction

Construction of Alternative 3 would disturb soils, which could increase erosion potential during heavy rains, floods, or daily tides once the surrounding levees are lowered. Construction of Alternative 3 would increase turbidity temporarily through scour and soil erosion until the streambanks and channels stabilize during the construction and transition period. Construction would be sequenced similar to the process described for the Proposed Action to avoid impacts to water quality as much as practicable. The BMPs related to soil erosion and sedimentation would be implemented to minimize transport of sediment to surface waters. These measures are described in Section 6. With the implementation of these BMPs, water quality impacts during construction would not be significant.

Transition Period and Long Term

Under Alternative 3, excess material from the removal of levees would be spread over large areas similar to Alternative 1. Therefore, there could be a moderate, local, adverse impact on water quality during the transition period from sedimentation and turbidity. This impact could be significant for a short period and would cease as vegetation becomes established on the project area. This is expected to occur within about 4 years (Section 4.5.2).

Over the long term, Alternative 3 would be expected to result in improved water quality in the bay and adjacent channels, similar to the Proposed Action.

Summary of Effects

Adverse construction and transition-period impacts of Alternative 3 on water quality would be moderate due to turbidity in surface waters. With the implementation of BMPs and mitigation measures described in Section 6, construction-related impacts would be minor and less than significant. Some moderate, local adverse impacts could still occur during the transition period that would be significant. Long-term water quality benefits of Alternative 3 would be moderate and local because of the reduction in agricultural uses and the restoration of wetlands. Impacts would be similar to those for the Proposed Alternative.

4.5.5 Groundwater Resources

This section describes groundwater resources in the study area and provides an evaluation of potential changes to groundwater levels and groundwater quality from the project alternatives.

4.5.5.1 Methodology

To determine potential impacts on groundwater resources, FEMA reviewed existing data on groundwater resources as well as EPA data to determine whether the project is located within or near any sole source aquifers. The geotechnical engineering analysis performed by Tillamook County also informed the analysis (Shannon & Wilson, Inc. 2014).

4.5.5.2 Affected Environment

The Tillamook alluvial plain is underlain by fine-grained marine sedimentary rocks and associated volcanic rocks. The material is of low porosity and permeability, and groundwater yield in the study area is low. In the project vicinity, groundwater flows west to northwest. Discharged groundwater provides much of the base flow during the summer dry season to the fluvial network.

Groundwater is used for irrigation as well as to supply a portion of the City of Tillamook's drinking water. Two groundwater drinking water supply wells are located on the east side of the City, and a third well is just northeast of the Highway 101 crossing of the Trask River. The wells are between 100 and 200 feet deep, with the static water level approximately 10 to 20 feet below grade. The City of Tillamook uses groundwater during the winter when surface water turbidity exceeds acceptable limits as well as during the summer when peak demand exceeds the surface supply capacity. Several irrigation wells are located near the study area, with yields ranging up to 1,200 gallons per minute; irrigation also serves to recharge groundwater supplies (ODEQ 2004).

The study area is not located within a sole source aquifer. The closest sole source aquifer is the Troutdale Aquifer System just north of Portland, Oregon, more than 50 miles to the east (EPA 2013).

Studies show nitrate, bacteria, and lead impact shallow groundwater in some basin areas. Potential sources for North Coast Basin groundwater nitrate and bacteria contamination are high, onsite septic system densities in areas with permeable, sandy soils. Poor well construction and maintenance activities can also lead to this contamination in the wells. Potential point sources for other toxic contaminants include the basin's landfills. Groundwater quality information collected from 1969 through 1976 showed increasing groundwater nitrate levels. The increases were related to increased housing density and onsite septic system use. Nitrate levels east of the City of Tillamook were between 2 and 10 mg/L (ODEQ 2004).

In the Tillamook area, a large majority of wells sampled (18 out of 25 = 72 percent) had nitrate levels less than 2 mg/L. None of the remaining wells had nitrate levels exceeding the drinking water standard of 10 mg/L. The groundwater sampled in this study represents deeper groundwater zones used for domestic drinking water and does not indicate shallow, near surface groundwater quality, more susceptible to contamination from anthropogenic activities (ODEQ 2004).

In the Tillamook area study, groundwater sampled from deeper water zones used for domestic drinking water showed only one well testing positive for bacteria. Resampling results for this well were negative for bacteria (ODEQ 2004).

In the Tillamook area, no pesticides were detected using analytical methods with reporting limits generally higher than 0.001 mg/L. In the Tillamook area, volatile organic compounds (VOCs) were not present except for one trace detection of ethylbenzene (ODEQ 2004).

In the Tillamook area, lead was found exceeding drinking water action levels in one well sampled in spring 1998 but was not detected when sampled initially in the previous fall. Antimony was initially detected and exceeded the drinking water standard of 0.006 mg/L in five out of 25 wells (20 percent) in fall 1997, but concentrations were not confirmed on re-sampling in spring 1998 (ODEQ 2004).

As part of the geotechnical investigation performed by Tillamook County in November 2014, several test pits were dug, and drilled borings were advanced in the SFC project area (Shannon & Wilson, Inc. 2014). Groundwater was encountered at depths ranging from 2.5 to 5 feet below grade. Groundwater throughout the site is hydraulically connected to portions of the Wilson and Trask rivers as well as to Hall, Dougherty, and Hoquarten sloughs. These rivers and sloughs are all tidally influenced, and shallow groundwater levels may fluctuate with the tide cycles, or there may be enough downgradient flow of fresh groundwater to prevent saltwater intrusion; however, there are no data available to confirm the existing condition. Regardless of the existing salinity gradient of the groundwater, it is apparent the shallow groundwater levels are deep enough that grass is able to grow on the adjacent floodplain, even in areas that have subsided, without being adversely affected by potentially saline groundwater.

Groundwater levels may vary with changes in precipitation as well as with surface water levels. Localized zones of perched water, above the river elevation, may also be present. In general, the highest groundwater levels will occur in late spring to early summer, and the lowest groundwater levels will occur in early to mid-autumn before the onset of the fall rainy season (Shannon & Wilson, Inc. 2014).

Groundwater Management Areas are designated by ODEQ when groundwater in an area has elevated contaminant concentrations resulting, at least in part, from nonpoint sources. The study area is not located within an ODEQ-designated Groundwater Management Area (ODEQ 2014).

4.5.5.3 Environmental Consequences

Based upon the regulatory framework established by the regulations discussed in Appendix C, and using the impact scale described in **Table 4.1-1**, a qualitative evaluation to evaluate potential impacts on groundwater was conducted. For the purpose of this EIS, a significant adverse impact would do any of the following:

- Substantially deplete groundwater supplies
- Interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table
- Affect the rate or change the direction of movement of existing groundwater contaminants or expand the area affected by contaminants

4.5.5.3.1 No Action Alternative

Construction

There would be no construction activities as part of the No Action Alternative; therefore, there would be no construction-related impacts on groundwater resources.

Transition Period and Long Term

Under the No Action Alternative, agricultural operations (grazing and hay production) would be phased out on the 392 acres in County ownership. The fields would no longer receive manure as fertilizer, and bacteria inputs to the water system would be reduced, which would potentially improve local groundwater quality by a minimal amount. There are no ongoing activities in the Tillamook Valley that would be expected to adversely affect groundwater resources in the foreseeable future.

Short- and long-term effects of the No Action Alternative on groundwater resources would be minor, local, and beneficial.

4.5.5.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Construction

Grading of portions of the project area may cause localized changes in groundwater levels that would be confined to the project area. Potential adverse construction-related effects on groundwater would be negligible and less than significant.

Transition Period and Long Term

Tidal hydrology would be re-introduced into the lower SFC project area, which could cause shallow groundwater levels in the lower portion of the project area to become further influenced by the tides. Shallow groundwater levels and salinity of shallow groundwater could increase within the project area. The rivers and sloughs adjacent to the study area are already tidally influenced and would remain so following construction of the project. Therefore, if tidal fluctuations influence shallow groundwater levels and salinity on the upgradient side of levees, then, conditions in the areas adjacent to the project area would not change. Construction of the project would shift the location of the levees but would not change the location of the tidally influenced rivers and sloughs relative to farmland outside of the project area. The location of levees on the surface would not be expected to alter the underground hydraulic connections of shallow groundwater and the river and slough channels. Therefore, there would be no change expected in shallow groundwater levels or salinity in areas adjacent to, but outside of, the project area. Drinking water wells drilled into the confined aquifer would not be affected. Reintroduction of tidal hydrology could increase shallow groundwater levels; however, these changes would be negligible, local, and less than significant based on experiences at other tidal restoration projects (Glamore and Indraratna 2009; Martin 2004). Because the sedimentary rocks and volcanic rocks that contain deeper deposits of groundwater are of low porosity and permeability, drinking water wells drilled into the confined aquifer would not be affected by potential changes to groundwater salinity.

Oregon regulations require that the permanent groundwater table must be at least 4 feet from the bottom of a septic system leachfield. Given this vertical separation distance that septic systems have been designed to meet along with the (lateral) distance that any septic systems are from the SFC project area, it is unlikely the alternative would affect septic systems. If groundwater levels were to rise up within the 4 foot separation distance, it would not affect the functioning of the system but could degrade the groundwater quality in the immediate area slightly. Given that there would only be one septic system remaining near the boundary of the project area, any potential effect on groundwater quality would be negligible. This system is also currently located close to Hall Slough and subject to tidal influences from the slough. The reconfiguration of the levee system to the west of this system would not affect groundwater levels.

As part of the Proposed Action, two houses would be demolished. Although the existing septic systems would remain in place following demolition of the houses, these septic systems would no longer actively contribute nutrients to the groundwater, which would improve groundwater quality in the long term. In addition, as surface water quality improves (see Section 4.5.4.3.2), groundwater quality would also improve.

Summary of Effects

Adverse construction impacts of Alternative 1 on groundwater resources would be negligible, local, and less than significant. There could be a minor, local, long-term improvement in groundwater quality due to removal of two septic systems in the project area.

4.5.5.3.3 Alternative 2: Hall Slough Alternative

Construction

The Hall Slough Alternative would have negligible, local effects on groundwater that would be less than significant. Although the channel would be deepened and widened approximately 2 feet or less (USACE 2005), it would not significantly affect groundwater resources.

Transition Period and Long Term

The existing tidal influences on the surface waters of Hall Slough would not be altered by the alternative and would not affect groundwater. Alternative 2 would not result in saltwater intrusion into areas adjacent to the Hall Slough project area.

Under Alternative 2, agricultural operations (grazing and hay production) would be phased out on the 392 acres in County ownership. The fields would no longer receive manure as fertilizer, and bacteria inputs to the water system would be reduced, which would improve local groundwater quality. This would be a minor, local short- and long-term beneficial effect.

As surface water quality improves through wetland restoration and improved riparian buffer vegetation, groundwater quality may also improve. In addition, given the required separation distance between the bottom of septic system leachfields and the groundwater table, it is unlikely the alternative would affect septic systems.

Summary of Effects

Adverse construction impacts of Alternative 2 on groundwater resources would be negligible, local, and less than significant. Short- and long-term impacts of Alternative 2 on groundwater resources would be minor, local, and beneficial.

4.5.5.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction/ Transition Period/ Long Term

Potential effects on groundwater under Alternative 3 would be similar to those described for the Proposed Action.

Adverse construction impacts of Alternative 3 on groundwater resources would be negligible and less than significant. Minor, local, long-term groundwater quality benefits would occur due to potential improvement in groundwater quality from the discontinued use of one septic system in the project area.

4.6 Biological Resources

Biological resources include vegetation, fish and wildlife, including migratory birds, and threatened and endangered species and critical habitats. This section provides an overview of the affected area and potential effects from each of the alternatives on biological resources. A more detailed description of the methodology used and the results of the evaluation are contained in the Biological Resources Technical Memorandum in Appendix G.

4.6.1 Vegetation

This section describes the vegetation communities in the project area. Additional detail on existing vegetation conditions and the analysis methodology and results may be found in the Biological Resources Technical Memorandum in Appendix G.

Vegetation is important for wildlife habitat, wetland and floodplain functions, and for protecting water and air quality. Changes in vegetation can affect these other resources. The regulatory framework for these related resources is described under each respective section. Additional information on applicable regulations may also be found in Appendix C. There are a few regulations specifically related to vegetation. The Noxious Weed Act (7 U.S.C. 2801 et seq.) and EO 13112, Invasive Species, require agencies to control noxious weeds and invasive plants. Similarly the Oregon Noxious Weed Control Law (Oregon Revised Statutes [ORS] 561) authorizes the Oregon Department of Agriculture (ODA) to protect Oregon's natural resources from the invasion and proliferation of exotic noxious weeds. The County and City comprehensive plans both identify protection of natural resources, which include vegetated areas, as important goals. Threatened and endangered plant species are discussed in Section 4.6.3 on Threatened and Endangered Species.

4.6.1.1 Methodology

Information on existing vegetation conditions and likely potential effects from the alternatives on vegetation were assessed based on the following:

- Review of historical aerial photographs and historical records to infer what "native" conditions may have existed prior to construction of levees and current land uses
- Review of the observed effects of other similar projects in Oregon, Washington, and California
- Descriptions of existing plant communities at reference sites (in the vicinity of the project as well as analogous projects) to describe current "native" communities and infer what are the future conditions that may result as a consequence of habitat restoration activities
- Review of project-specific studies, including hydraulic modeling conducted by the applicant, along with data on tidal elevations to establish expectations for the effects of

water depths that would affect which plant communities would grow under the changed or restored water regimes

A general field reconnaissance was conducted to further evaluate existing conditions in the study area, and descriptions were confirmed with researchers who are currently conducting ecological monitoring of the SFC study area. The potential impacts of each alternative on vegetation communities were evaluated and are described in the environmental consequences section.

4.6.1.2 Affected Environment

This section describes existing vegetation communities in the study area. Special-status plant species, including federal- and state-listed plants, are discussed along with special-status wildlife species in Section 4.6.3.

The Tillamook Valley is located in the Coastal Lowlands ecoregion (Franklin and Dyrness 1973; Omernik and Gallant 1986; Thorson et al. 2003). Coastal Lowlands occur in the valley bottomlands of the Coast Range mountains. Valley bottomlands are unique ecosystems that were nearly completely forested prior to Euro-American settlement. These systems have been extensively altered as a result of agricultural use and urban development. Historically, conifer trees were more common than hardwoods in the Tillamook valley. The predominant conifer was spruce, and bottomland areas generally supported many large spruce trees in the Tillamook area (Nonaka et al. 2002). Historical vegetation cover maps for the Tillamook valley suggest the eastern portion of the study area was forested at the time of early Euro-American settlement. The western portion was not tree covered (Nonaka et al. 2002). Current mapping indicates nearly all tree-covered areas in the Tillamook valley have been lost, with most of the area converted to agriculture (Nonaka 2003).

Typical vegetation that historically would have occurred naturally in the project area would include Sitka spruce (*Picea sitchensis*), western redcedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), and grand fir (*Abies grandis)* in the canopy, with salal (*Galtheria shallon*), sword fern (*Polystichum munitum*), vine maple (*Acer circinatum*), and Oregon grape (*Mahonia* sp.) in the shrub layer. These species still occur in patches in the study area today. Riparian areas contain red alder (*Alnus rubra*), western redcedar, and bigleaf maple (*Acer macrophyllum*), with a salmonberry (*Rubus spectabilis*) understory. Estuaries and coastal wetlands consist of Baltic rush (*Juncus balticus*), Lyngby's sedge (*Juncus lyngbyi*), tufted hairgrass (*Deschampsia cespitosa*), Pacific silverweed (*Potentilla pacifica*), and seaside arrowgrass (*Triglochin maritime*), with shore pine (*Pinus contorta*), sweet gale (*Myrica gale*), and Hooker's willow (*Salix hookeriana*) (Franklin and Dyrness 1973).

Vegetation communities present within the study area are shown on **Figure 4.6-1**. Existing vegetation within the study area includes freshwater wetland, tidal wetland, and upland vegetation communities (Brophy 2014b). **Table 4.6-1** presents a summary of the types and acreages of existing vegetation communities within the study area for each alternative.

Table 4.6-1. Summary of Existing Vegetation Communities for each Alternative

Vegetation Community [1]	Proposed Action (acres)	Hall Slough Alternative (acres)	Initial Alternative (acres)	Typical Vegetation
Freshwater Wetland				
Diked emergent wetland, active pasture (2)	220.05	7.84	170.92	Pasture grasses, reed canarygrass, Pacific silverweed, soft rush
Diked emergent wetland, cropped (1)	62.69	---	62.68	Meadow foxtail, reed canarygrass
Diked emergent wetland, inactive/abandoned pasture (3)	117.49	---	115.09	Reed canarygrass, slough sedge, cat-tail, spikerush, Pacific silverweed
Diked scrub-shrub (4)	40.95	---	40.98	Hooker's willow, red elderberry
Diked forested wetland, Sitka spruce, non-tidal (6)	42.79	---	42.79	Sitka spruce, Hooker's willow, red elderberry
Diked forested wetland, red alder (7)	17.66	---	17.66	Red alder
Diked forested wetland, Sitka spruce/red alder (8)	7.81	---	---	Sitka spruce, red alder
Tidal Wetland				
Estuarine emergent (9)	2.95	---	2.95	Emergent herbaceous species include Baltic rush, Lyngby's sedge, tufted hairgrass, Pacific silverweed, seaside arrowgrass
Diked forested wetland, Sitka spruce, tidal (5)	32.93	1.34	32.93	Sitka spruce
Upland				
Riparian forested (10)	42.85	27.13	42.85	Sitka spruce/ western hemlock, and red alder/black cottonwood/willow
Riparian scrub-shrub (11)	1.73	1.47	---	Red alder, willow, black twinberry, Pacific crabapple, salmonberry, red elderberry, Himalayan blackberry, cutleaf blackberry, Scot's broom
Upland forested (12)	44.89	---	46.65	Sitka spruce, red alder
Upland pasture/cropped/mixed use (13)	0.03	75.96	---	Pasture grasses, hay crops, ornamental landscape vegetation

*1- Numbers in parentheses correspond to the vegetation community numbers on **Figure 4.6-1.***

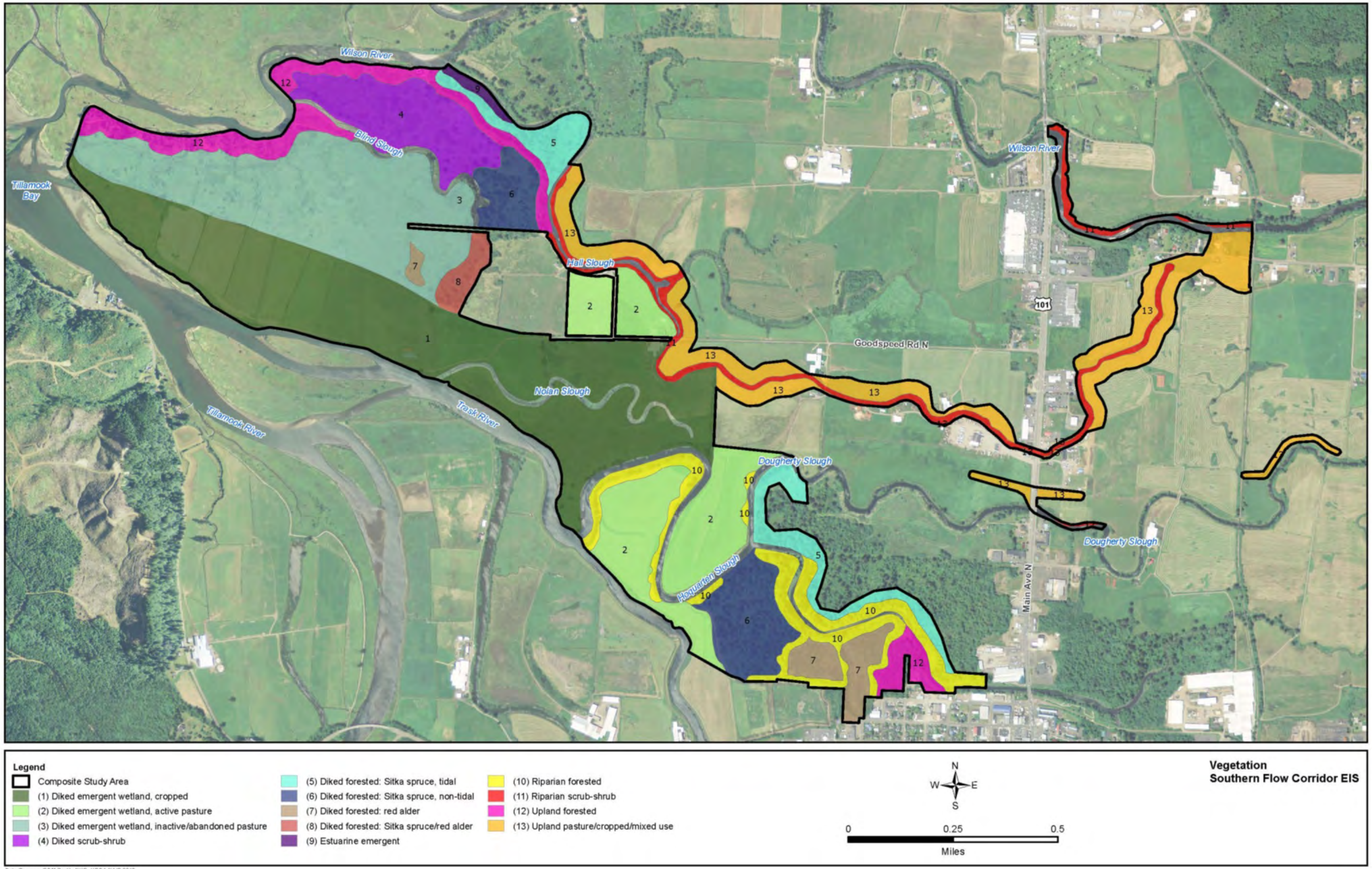


Figure 4.6-1. Vegetation Communities in the Study Area

4.6.1.2.1 Wetland Vegetation

Wetland vegetation communities within the project area include emergent, scrub-shrub, and forested communities. There are several subcategories under each of these broad wetland vegetation types as shown on **Figure 4.6-1**. The wetland types are discussed in detail in Section 4.5.2. Wetland vegetation types represent the majority of the vegetation communities within the study area and are predominantly found within the SFC area (**Table 4.6-1** and **Figure 4.6-1**). Section 4.5.2 includes a discussion of wetland functions and describes the existing condition of wetlands within the study area.

4.6.1.2.2 Riparian

Riparian areas are the vegetated areas along a waterbody. Typically, they provide a natural buffer between the waterbody and adjacent uplands. Healthy riparian areas provide shade to regulate stream temperatures, stabilize streambanks, filter sediments and pollutants, provide habitat and wildlife corridors, and increase large wood recruitment to streams (TEP 2010).

Riparian vegetation throughout the study area is generally limited (**Figure 4.6-1**) and in poor condition except on Hoquarten Slough (Brophy 1999). Riparian trees are largely absent as streams pass through predominantly agricultural land. However, Sitka spruce-dominated stands and groves of red alder are found in substantial quantities along Hoquarten Slough through much of the study area. Outside of the riparian forest along Hoquarten Slough, the composition of the riparian scrub/shrub is primarily blackberries and non-native grasses or other brush and young hardwoods. Riparian vegetation in the study area is generally discontinuous (TBNEP 1998b). The well-developed riparian forest along Hoquarten Slough is characterized by Sitka spruce and western hemlock (TEP 2010).

Vegetation along Hall Slough is typical of that of other streams in the study area, consisting of a very narrow riparian corridor, generally less than 25 feet wide, surrounded by active pasture and farmland. Data on riparian vegetation along Hall Slough is not currently available; however, information from Brophy (2015a) suggests probable vegetation in this area includes red alder, black twinberry (*Lonicera involucrata*), Pacific crabapple (*Pyrus fusca*), salmonberry, red elderberry (*Sambucus racemosa*), and Hooker's willow with Himalayan blackberry (*Rubus armeniacus*), cutleaf blackberry (*Rubus laciniatus*), and Scotch broom (*Cytisus scoparius*) present in disturbed areas along the edges of fill along dikes and roads. This riparian forest is discontinuous and consists primarily of deciduous species, but there are occasional spruce trees visible in aerial photos of the study area.

4.6.1.2.3 Upland Vegetation

Upland vegetation within the study area generally consists of predominantly non-native grasses and forbs or planted ornamental species. Uplands within the study area include several very small patches at the highest portions of the levees along Hoquarten Slough and along Hall Slough in areas associated with the Hall Slough Alternative. Upland areas are generally either in urban land uses or are used for pasture.

Trees

Limited tree surveys were conducted by the Tillamook County surveyor within the study area (NHC 2014a). The surveys were generally conducted in areas where disturbances are proposed under the Proposed Action; for example, along levees and fill that would be removed or where new levees would be built (**Figure 4.6-2**).

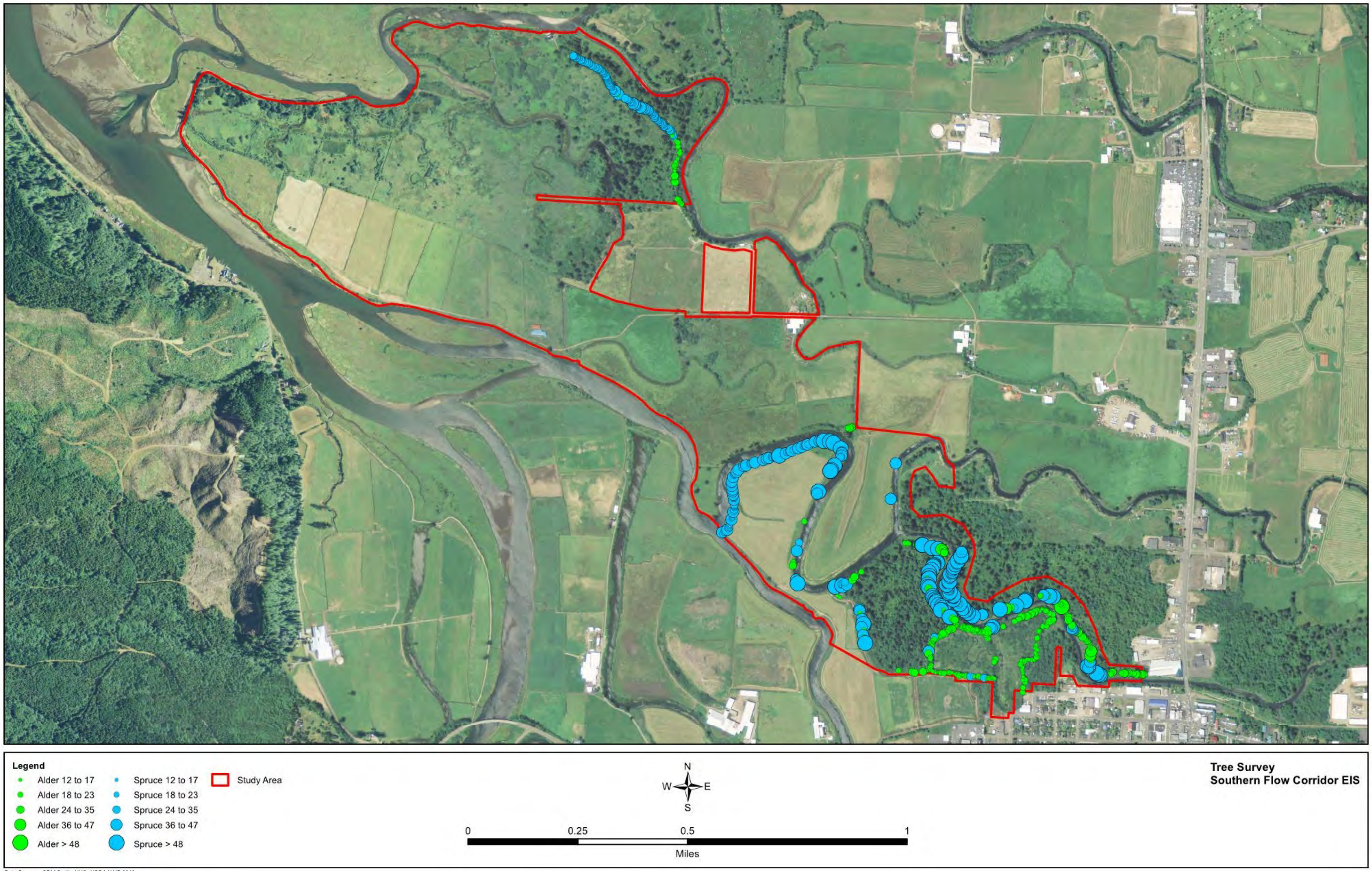


Figure 4.6-2. Survey of Trees (by Diameter at Breast Height) in the Study Area

The tree survey documented approximately 450 red alder and 200 Sitka spruce in the area along Hoquarten Slough in the southeastern portion of the study area. Sitka spruce may provide potential nesting habitat for the federally listed threatened Marbled murrelet (see Section 4.6.3 for discussion of potential impacts to this and other listed species). The survey also documented spruce groves and a few spruce along Hall Slough in the northwestern portion of the study area. The existing distribution of spruce and alder by size class is provided in **Figure 4.6-2**.

4.6.1.2.4 Invasive Species

An important goal of the Tillamook Bay *Comprehensive Conservation and Management Plan* is to control the spread of existing invasive exotic plant species and prevent the introduction of new invasive exotic plant species (TBNEP 1999). Exotic species can aggressively alter the landscape by displacing native species. A list of non-native and invasive plant species currently occurring or potentially occurring within the Tillamook area is provided in Appendix G.

Four invasive species are of particular concern in the Tillamook Bay estuary: smooth cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*Spartina patens*), purple loosestrife (*Lythrum salicaria*), and reed canarygrass. The importance of these species is attributed to the following characteristics:

- They are wetland plants that can occupy large areas of current and former tidal wetlands to the exclusion of native species.
- They are on the ODA's "T" list (ODA 2014), indicating they are to be considered economic threats to the state.
- Three of the four (cordgrasses and purple loosestrife) are tolerant of brackish water, making them threats in the estuary.
- ODSL's *The Tillamook Bay Comprehensive Conservation and Management Plan* identifies prevention and/or control of cordgrasses and purple loosestrife in its "Key Habitat Action Plan" (TBNEP 1999).

Cordgrass has not been documented in the Tillamook Bay estuary, but two species, smooth cordgrass and saltmeadow cordgrass, have been documented in Oregon (Ewald and Brophy 2012). Both species are invasive in the Pacific Northwest and considered a serious threat to Oregon estuaries in general. Saltmeadow cordgrass is illustrated in **Figure 4.6-3**.

Purple loosestrife has been documented in the Tillamook Bay estuary (Ewald and Brophy 2012). It is an invasive, non-native wetland plant and a serious threat to freshwater and brackish water wetlands throughout the Pacific Northwest. **Figure 4.6-4** shows purple loosestrife established in this type of habitat.

Reed canarygrass is very widespread in the low-brackish to freshwater tidal portion of the estuary, particularly in disturbed areas and along river banks (Ewald and Brophy 2012). This species is intolerant of highly saline water but is able to persist in slightly brackish water. As a result, it is common in altered tidal wetlands where saltwater has been excluded by diking, tide gates, or restrictive culverts. Reed canarygrass forms dense single-species stands that exclude other species (Ewald and Brophy 2012). **Figure 4.6-5** shows reed canarygrass established in this type of habitat.

Figure 4.6-3. Saltmeadow Cordgrass

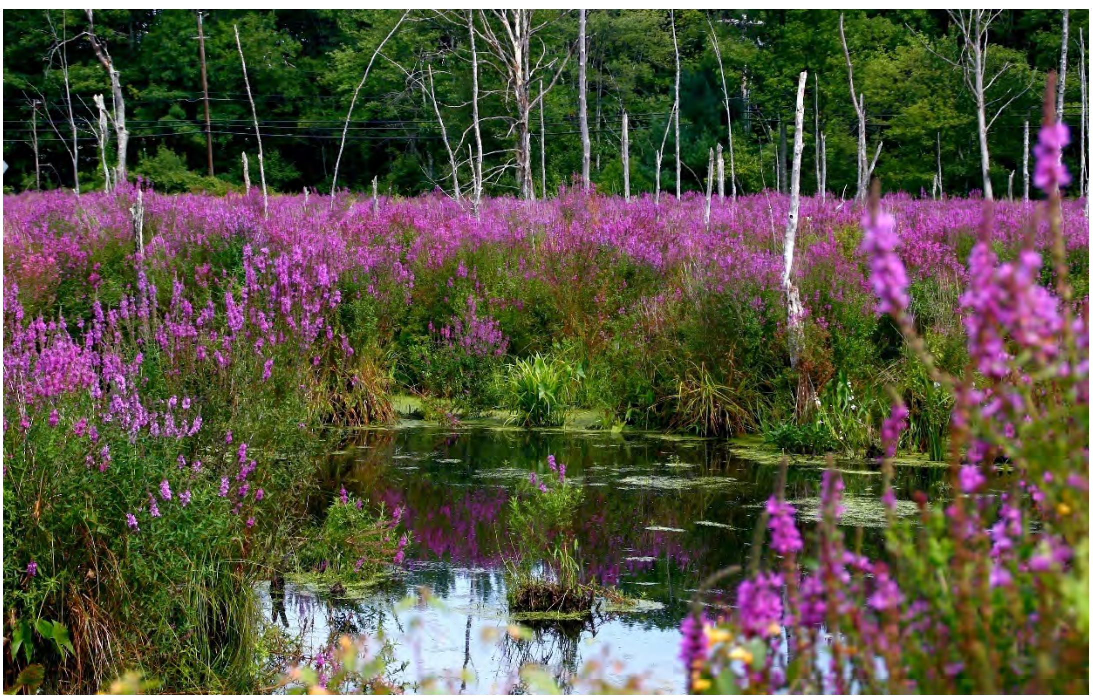


Figure 4.6-4. Purple Loosestrife in Wetland Habitat

Figure 4.6-5. Reed Canarygrass in Altered Tidal Wetland Habitat

Several other invasive species are found in the Tillamook Bay estuary. The Oregon Weedmapper application (http://www.weedmapper.oregon.gov/) shows several populations of Himalayan, Japanese, and giant knotweed (*Polygonum polystachyum, P. cuspidatum,* and *P. sachalinense,* respectively) as well as yellow flag iris (*Iris pseudacorus*).

4.6.1.3 Environmental Consequences

Effects of each alternative were quantified based on the type and extent of project activities and included consideration of measures proposed to avoid adverse effects. Comparisons were made among the alternatives to evaluate relative levels of significance. For each action alternative, the impact analysis includes summaries of short-term (effects occurring during construction; a period of 1 to 2 years), transitional (2 to 10 years, depending on the vegetation type and includes the period when plants become established and adapt to new physical site and habitat conditions), and long-term (10 to 50 years) effects.

Impacts to vegetation would be significant if implementation of an alternative results in the permanent loss, degradation, disturbance, or fragmentation of natural vegetation communities. Natural vegetation communities are composed predominately of native plants and include those that would be expected to occur in the study area in the absence of landscape modifications such as levees.

4.6.1.3.1 No Action Alternative

Construction

Under the No Action Alternative, the existing mix of vegetation communities, including emergent wetlands (pasture and non-pasture), shrub/scrub wetlands, and mature Sitka spruce riparian/tidal forested wetlands would remain. Seasonal flooding from recurrent flood events would result in continued flooding of low-lying areas. There would be no construction–related impacts on vegetation under the No Action Alternative.

Transition Period and Long Term

Over the long term, non-native and invasive plant species currently in the wetlands likely would increase as a result of seed transported by floodwaters. Agricultural operations would be phased out on the 392 acres in County ownership (of which approximately 152 acres are in current agricultural production), and this area would gradually convert to freshwater wetlands.

Additionally, the development and succession of plant communities would continue to occur. Some expansion of willow dominated shrub/scrub wetlands would occur in current emergent wetlands without grazing pressure, and some sedimentation and closure of waterways would occur over time. The 152-acre area of pasture and hayfield within the County owned lands would likely transition to a similar shrub-dominated system with cessation of grazing. The Sitka spruce stands in the eastern and north-central portions of the project area would remain, as no substantial change in the hydrologic regime would be expected. Some large diameter Sitka spruce trees could be lost through winter storms, flood inundation, and senescence although this vegetation type could potentially expand in the project area. Over the long-term, the No Action Alternative would result in minor, local, beneficial effects on vegetation.

4.6.1.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

In contrast to the No Action Alternative, the Proposed Action would result in modification of existing vegetation and would ultimately result in a major shift in vegetation community types within the project area. Approximately 522 acres of tidally influenced wetlands would be restored in the areas re-opened to tidal influences. The majority of the existing wetlands would be converted from freshwater emergent wetlands to estuarine tidal wetlands with a saline or brackish water regime. Most of the existing freshwater wetland and pasture vegetation would be unable to tolerate the saline waters that would enter the site, and some vegetation is expected to die off quickly (NHC 2010). Changes in wetland vegetation are expected to be among the most dramatic changes in vegetation under the Proposed Action, and effects on wetlands are described in more detail in Section 4.5.2.

Construction

Vegetation would be removed during construction in areas where levees would be removed, modified, or constructed. To the extent practicable, existing spruce trees would be protected, especially those trees with a physical structure that could support Marbled murrelet nesting. Approximately 100 to 150 spruce trees and all the red alder trees along Hoquarten Slough in the southeastern portion of the study area would be removed; approximately 40 to 50 trees would be retained (see **Figure 4.6-7**). Several hundred more spruce would be removed along Hall Slough as a result of the berm removal along Hall Slough in the northwestern portion of the study area. Approximately 5 to 10 trees would be retained in this area (see **Figure 4.6-7**). The size range and number of surveyed trees within the project area are shown on **Figure 4.6-6**. **Figure 4.6-7** shows areas where surveyed trees would be retained along levees (surveyed trees were shown on **Figure 4.6-2**).

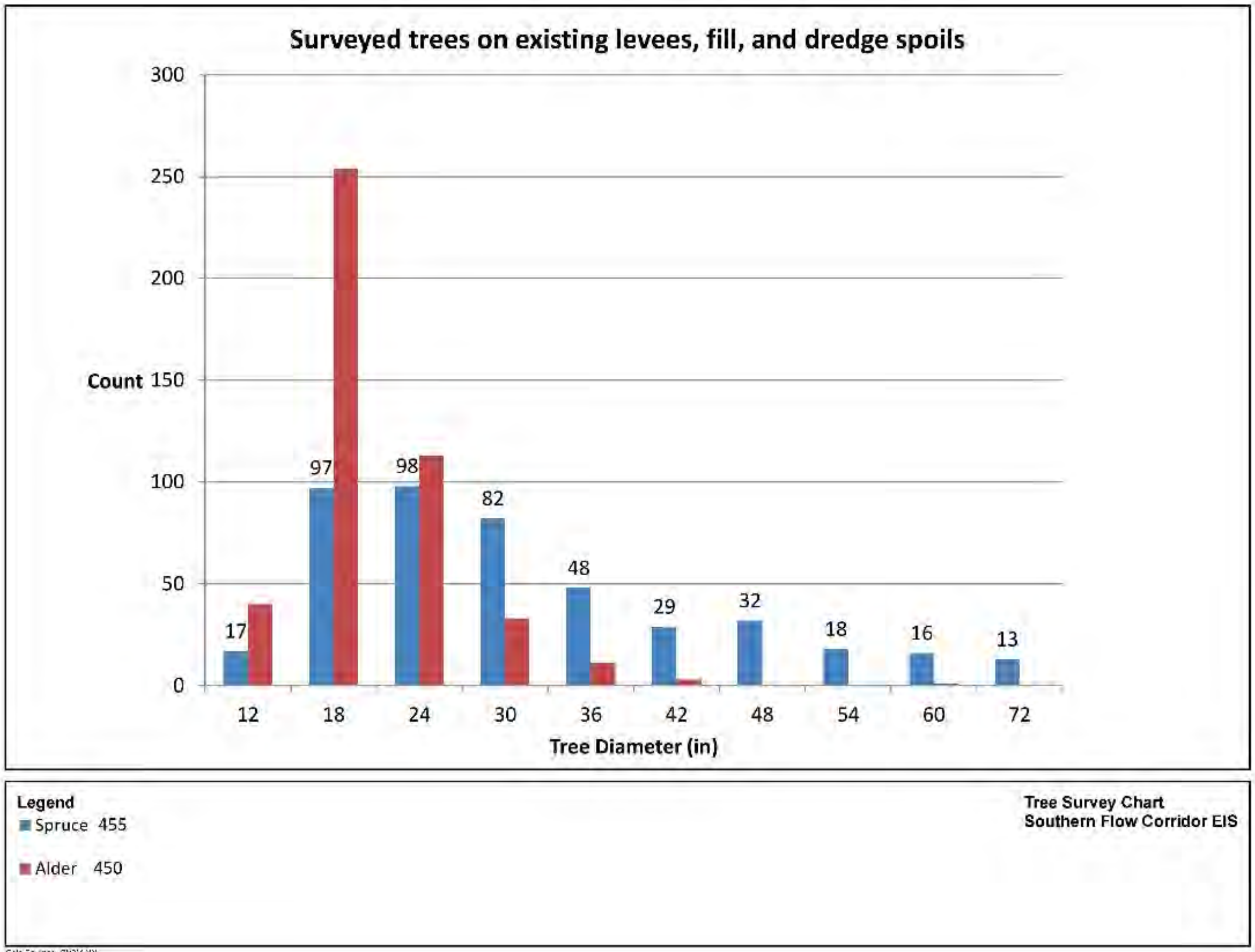


Figure 4.6-6. Number of Surveyed Trees by Species and Size

Some of the removed spruce trees would be reused on site to provide large woody debris and habitat structures within the restoration area (use of salvaged trees for habitat structures is discussed further in Section 4.5.1.3.2 and Section 4.6.2.3.2). The number of trees to be used on site would be determined during final design and depend on the feasibility of salvage or their suitability for reuse. Trees used as habitat structures typically include root wads and 20 to 30 feet of trunk. Some trees would be reserved for use in offsite restoration projects.

Branches and other vegetative debris would be chipped on site and used for hog fuel on access roads and as brush berms or other temporary erosion and sediment control. Bigger limbs and tops would be used in place for temporary plank roads for construction access. These plank roads would remain post-project and would deteriorate in place. Levee sideslopes of the new setback levees and modified levees would be hydroseeded for erosion control. No other revegetation or hydroseeding is proposed.

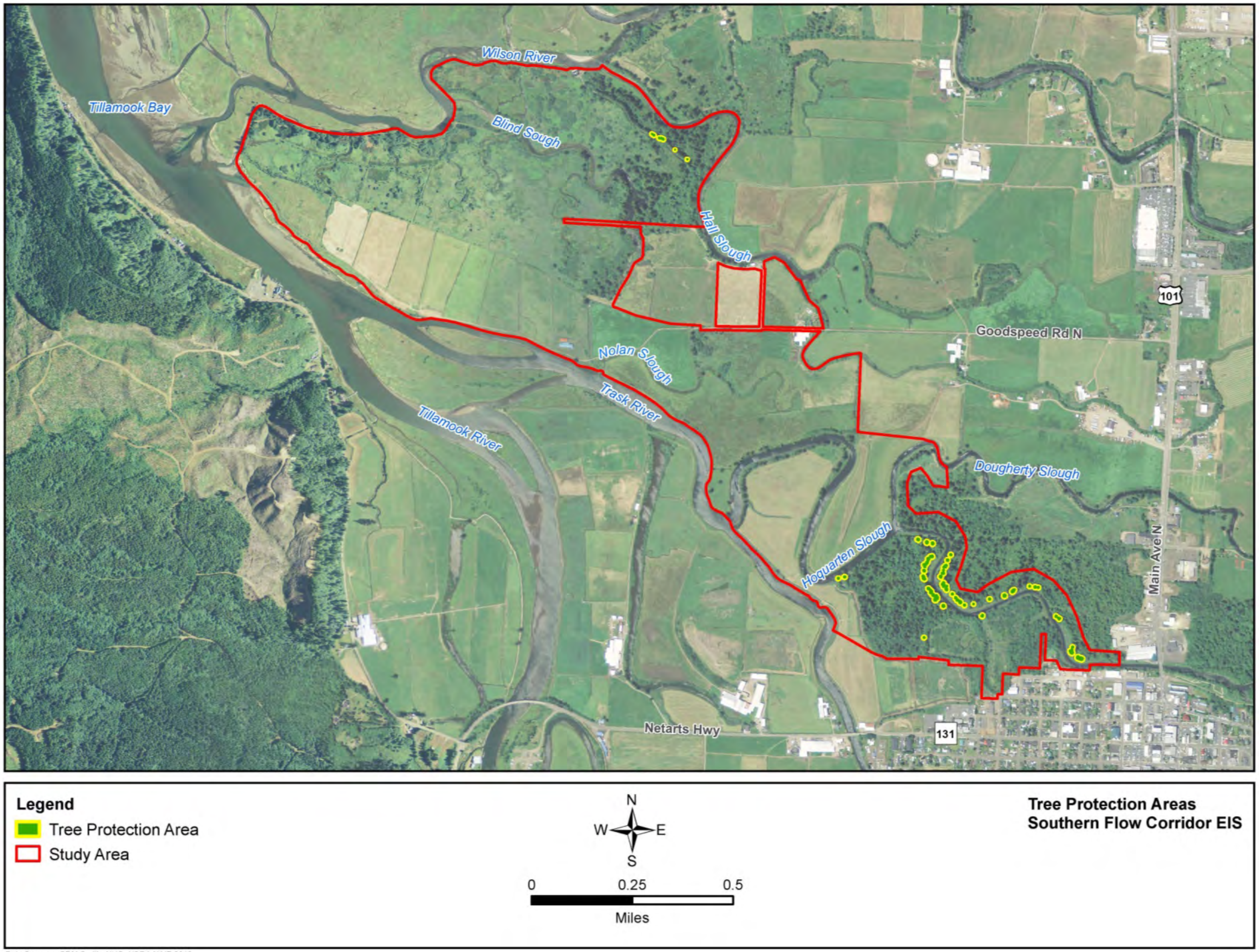


Figure 4.6-7. Tree Protection Areas

Under the Proposed Action, there would be moderate, local changes in the vegetation on site. The removal of mature spruce trees and the fragmentation of forested areas within the project area by levee removal and construction would be an adverse impact during construction. However, this effect would not be considered significant because of the small area affected and the retention of some portions of mature spruce on remnant levees.

During construction, measures would be implemented to control the introduction and spread of invasive species in the project area. Vehicle wash stations would be located at strategic construction site exits determined by the contractor in compliance with federal and state permit conditions. To ensure non-native or invasive plants or seeds are not introduced or spread in the project area, the contractor would wash soil and plant material off all equipment tires and treads before moving from one area to another (or moving to and from the staging area to the work area).

Transition Period

Following removal of the perimeter levees, vegetation communities would transition to a species assemblage tolerant of saline or brackish water over time (Myers 1996; Thom et al. 2002; USFWS 2014a; Warren et al. 2002). During this transition period, the existing vegetation would be expected to change in response to changes in hydrology and salinity. These changes are necessary to restore the project area to the desired goal of a functional tidal marsh. Changes in wetland communities are described in more detail in Section 4.5.2.

Lower portions of the spruce forest in the northwest corner of the project area likely would die off, either through salinity or simply higher water levels (NHC 2011). Forested areas would transition to the tidal wetlands that would be typically expected in low-lying areas adjacent to the bay. Over time, natural vegetation communities would become re-established according to the natural hydraulic and salinity regimes that would be re-introduced with the removal of the levees. Areas that transition from forested or scrub-shrub vegetation would be expected to experience die-off within the first year or two following levee removal. Standing dead trees may persist for several more years in these areas.

Some trees in the forested wetlands near the southeastern portion of the project area near the City of Tillamook may also die off due to higher water levels after dike removal; however, mortality likely would be less than in forested areas farther west as there would be fewer changes in salinity and water levels from re-introduced tides. Mature trees that are currently growing on the levees in the southeastern portion of the project area would also be removed when the levees are removed (except as shown on **Figure 4.6-7**). If these areas retain conditions suitable for the growth of spruce trees, then they would be expected to become re-established over time. There would be a moderate, temporal, local, adverse impact on this vegetation community because it would take time for new trees to attain the size and provide the same functions as the existing mature trees. This effect would not be considered significant because of the small area affected, the retention of some portions of mature spruce on remnant levees, and the re-establishment of natural vegetation communities across the project area.

At lower elevations in the western portion of the project area, tidal influence would be greatest, with more a saline water regime and salt marsh vegetation. Toward the east, water would be expected to be more brackish and support salt marsh vegetation that is tolerant of brackish water. Further east, and at higher elevations within the project area, freshwater vegetation would be expected to dominate. Salinity levels are associated with elevation, and elevations would be expected to change over time as flows and sediment transport mechanisms are restored into the project area. While there is some uncertainty with respect to where within the project area the vegetation would transition from salt marsh to freshwater marsh in the long term, both salt marsh and freshwater marsh vegetation is expected to consist of non-woody plants (e.g., herbaceous plants, reeds, bulrushes), rather than trees or shrubs that could potentially impede flood flows in the long term.

Natural tidal processes would bring in the water, salinity, sediment, and seeds that would initiate restoration (NHC 2010). There may be some areas where riparian vegetation would establish naturally along stream channels in higher areas, providing increased habitat diversity, cooler water temperatures through shading, and streambank stabilization (TBNEP 1999). Tree species that likely would establish include willow, black cottonwood, and red alder. Under good growing conditions, the growth rates for alder and cottonwood are 3 to 4 feet per year and 1 to 12 feet per year, respectively, indicating these species would provide good shade and cover after approximately 10 to 15 years (Huff et al. 2013).

Blind Slough would be lengthened to connect to Hall Slough, which would require the removal of some existing wetland vegetation and likely establish brackish water or saline tolerant tidal wetland vegetation communities adjacent to the new channel. Other new channels would be constructed on the downstream ends of the new flood control structures in the new levees and at the upstream end of Nolan Slough. These areas are currently primarily pasture or hay fields; therefore, impacts on vegetation from channel construction would be minor.

At approximately 20 locations, existing riprap would be removed to help reestablish channel connections with the bordering rivers and sloughs and encourage the historic side channels to reform on the interior (shown on **Figure 3-2**). As these side channels re-form, the vegetation communities would be expected to diversify as different elevations and permanent water courses develop.

Figure 4.6.8 shows vegetation changes from a tidal restoration project at the Nisqually Wildlife Refuge that is similar in scope to the Proposed Action. The top photo in **Figure 4.6.8** is from May 2009, prior to the restoration. The white line is the existing levee crest; the area to the left of the levee is natural tidal marsh while the area to the right is protected from the tides by the levee. Vegetation at this time was similar to what exists in the study area for the Proposed Action. The bottom photo was taken in May 2013, post-restoration. The subsided lands have converted entirely to mudflat, and sediment accretion has not yet occurred to the point where natural marsh vegetation can establish. Other tidal wetland restoration projects in Oregon have found that it may take a couple of years for the existing vegetation to break down, and often the new vegetation grows on top of the old vegetation for a few years (Brophy 2015b). This was observed following implementation of the Ni-les'tun Tidal Marsh Restoration Project at the Bandon Marsh National Wildlife Refuge, shown in **Figure 4.6.9**.

Figure 4.6-8. Pre- and Post-Restoration at the Nisqually Wildlife Refuge

Reference sites for the proposed project have been identified in the *Southern Flow Corridor Project Effectiveness Monitoring Plan* (Brophy and van de Wetering 2014). Transitions in the vegetation on site would be monitored according to the monitoring plan and results compared against the reference sites. Monitoring results would allow for an evaluation of progress of the restoration project. Monitoring would track changes in biological and physical parameters, including vegetation in the project area, and would identify areas where adaptive management may be needed to achieve restoration of tidal marsh communities. Monitoring was begun in spring 2014 to establish baseline conditions and would continue following implementation of the project. The County and POTB would develop a maintenance and monitoring plan as a condition of their grants that will include performance standards and adaptive management components for vegetation.

Photograph by Laura S. Brophy

Figure 4.6-9. Old and New Vegetation Following Restoration at Bandon Marsh National Wildlife Refuge

Long Term

Over the long term, there would be a major beneficial change in the vegetation communities as the natural plant communities that would typically occur in low-lying areas along the bay would be restored. This would improve the functions of the natural vegetation communities. Areas would become less fragmented as roads, levees, and areas of non-native pasture and agricultural fields are removed and restored. The reconnection of vegetation communities within the project area with adjacent tidal marshes and other habitats along the bay would have regional beneficial effects.

Control of invasive plants would be an important component of the monitoring program and adaptive management to ensure success. In the long term, implementation of weed control measures along with natural recruitment of more saline-tolerant species (Smith and Warren 2012) likely would make the initial increase in non-native and/or invasive species a negligible to minor impact. At the Nisqually Delta tidal restoration project in the Puget Sound area, where reed canarygrass accounted for approximately 75 percent of the vegetation cover prior to restoration, less than one percent cover of reed canarygrass was detected at monitoring locations the year following re-introduction of tidal waters (Woo et al. 2011a).

There are several invasive species adapted to saline environments that may potentially colonize the project area. Invasive species of greatest concern are listed below; however, other tidal marsh restoration projects in the Pacific Northwest have not reported problem occurrences with these species (Brophy 2009); Frenkel 1995; Woo et al. 2011a). At the Salmon River Estuary restoration site, pasture species killed by saltwater were displaced initially by the annual marsh colonizers brass buttons (*Cotula coronopifolia*) (non-native) and sand spurry (*Spergularia marina*) (native). These were eventually replaced by the regionally common native species Lyngby's sedge (*Carex lyngbyei*), Virginia glasswort, (*Salicornia virginica*), and saltgrass (*Distichlis spicata*) (Frenkel 1997). One year following restoration, vegetation at the Nisqually Delta site consisted of a mix of predominantly native species, including pickle-weed (*Sarcocornia pacifica)*, saltgrass, and Baltic rush (*Juncus balticus*) (Woo et al. 2011a).

If any of the problem species do invade the project area, the control measures described below may be employed to control them. Because of the sensitivity of the bay and the fact that the future condition of the project area would be one of a semi-aquatic area with daily tides connected to the bay, any invasive species-control measures would be appropriate for use in a tidal marsh habitat. This would limit the potential use of herbicides to those approved for use in aquatic environments, and preference would be given to other control methods.

Cordgrass or spartina can be controlled by physical means (e.g., digging, mowing, covering, and tilling) if the population size is small (Pfauth et al. 2003). Glyphosate treatment is effective in some situations. Biological control is not an eradication technique but may be effective in an integrated management strategy for large populations.

Purple loosestrife can be controlled manually, preferably before seed set, if infestations are small and plants are young (U.S. Forest Service 2015). Older plants can be controlled by mid-summer and late season spot treating with a glyphosate type herbicide. Biological control is recommended for long-term control of large infestations.

Manual controls for reed canarygrass include digging, mowing, cultivating, and flooding (Tu 2004). Limited experimentation with mowing and discing reed canarygrass at the Nisqually Delta tidal restoration site indicates this may be an effective method of control (Woo et al. 2011b). Prescribed fire may be combined with other treatments. Various herbicides, including glyphosate, are available for chemical treatment. There are no known biological control agents.

Summary of Effects

Under the Proposed Action, there would be moderate, local changes in the vegetation on site. Mature trees and woody riparian vegetation along sloughs and levees and non-native pasture vegetation would be removed. In the short term (1 to 2 years), implementation of this alternative would result in moderate, local impacts on vegetation as a predominantly saltwater regime is established. Impacts would continue to be moderate on a local scale during the transition period following implementation (approximately 2 to 10 years), as the existing vegetation dies and begins to be replaced with vegetation tolerant of saline conditions. Existing vegetation that would be lost is predominantly pasture or non-native vegetation. Implementation of this alternative would result in a transition of the existing vegetation communities to predominantly natural tidal wetland vegetation communities.

Over the long term (10 to 50 years), the effects would be beneficial because natural vegetation communities would be restored and reconnected to other areas around the bay. In the long term, Alternative 1 would provide major local and regional benefits as tidal wetlands typically present in the low-lying areas around the bay are re-established. Limited areas of forested vegetation communities may persist or become re-established in disturbed areas over time in portions of the project area that are higher in elevation and less tidally influenced. However, the predominant vegetation community types are anticipated to be herbaceous. Re-establishment of tidal vegetation communities would result in increased habitat complexity, connectivity, and availability, providing major ecological benefits.

4.6.1.3.3 Alternative 2: Hall Slough Alternative

Construction

During construction, the narrow band of existing woody riparian vegetation would be disturbed where levees would be set back or modified. The areas where new setback levees would be placed are entirely pasture; therefore, there would be a minor local effect on vegetation from the new setback levees.

The existing levees that would be removed and the banks of the slough currently support riparian vegetation. This vegetation is discontinuous but does include a variety of shrubs and trees, including species such as salmonberry, twinberry, red elderberry, Hooker's willow, and the occasional spruce, and non-native species such as Himalayan blackberry and Scot's broom. Some of the trees along Hall Slough upstream of Goodspeed Road are mature trees that provide habitat features in an otherwise disturbed landscape. Short-term impacts would occur during the construction period (1 to 2 years) and would be associated with the channel widening. Impacts would include removal of approximately 9 acres of woody riparian vegetation. The loss of this vegetation during construction would be a moderate, local, adverse impact. Areas disturbed during construction would be hydroseeded to minimize soil erosion.

Transition Period and Long Term

The moderate local impacts on vegetation following the initial short-term construction period would continue for the transition period following construction (approximately 2 to 10 years) as riparian shrubs and trees would be expected to re-establish on the new banks.

Over the long term (10 to 50 years), riparian vegetation would mature, and the total area of riparian and wetland vegetation would increase as compared to the No Action Alternative. The area between the top of the new channel banks and the new setback levees would be approximately 90 acres. Potentially, all of this area could convert to wetlands and riparian vegetation. Outside of the existing levees, the vegetation is currently all pasture; therefore, this would represent a moderate local increase in habitat diversity and function. Tidal wetland conditions may also develop in the area between the setback levee and the new, widened channel, especially in the lower reaches of the slough, producing a shift from freshwater to tidal marsh vegetation.

Changes in vegetation communities across the larger SFC study area would be similar to the No Action Alternative because actions would be limited to a narrow corridor along Hall Slough. Similar to the No Action Alternatives, agricultural operations would be phased out on the 392 acres in County ownership (of which approximately 152 acres are in current agricultural production), and this area would gradually convert to freshwater wetlands.

The County and POTB would develop a maintenance and monitoring plan as a condition of their grants that will include performance standards and adaptive management components for vegetation. The long-term effects of the Hall Slough Alternative on vegetation would be moderately beneficial at the local scale because there would be an increase in the area of riparian and wetland vegetation communities in the areas of the setback and new widened channel and on the County-owned land in the SFC area.

4.6.1.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction

Impacts associated with Alternative 3, the Southern Flow Corridor – Initial Alternative, would be similar to those described for the Proposed Action. Like the Proposed Action, and in contrast to the No Action Alternative, Alternative 3 would modify existing vegetation communities and ultimately result in a major shift in vegetation community types to the natural tidal wetland communities expected of low-lying areas along the bay. Alternative 3 would re-establish tidal connectivity and result in a net increase of approximately 568 acres of restored tidal wetlands. This restoration would result from the removal of existing levees and the restoration of tidal influences, resulting in the conversion of existing drained and diked farmland and other diked uplands and freshwater wetlands. The same changes in vegetation would be expected to occur under this alternative as described for the Proposed Action except that a somewhat larger area would be restored to the historic tidal wetland condition (568 acres versus 522 acres). Trees along the existing levees would be handled in the same way as described for the Proposed Action, with some being left in place as living trees, some reused on other portions of the site for habitat structures, and others removed for reuse in offsite restoration projects or resale. In the short term (1 to 2 years), implementation of this alternative would result in moderate, local, adverse impacts on vegetation as trees and other riparian vegetation would be removed.

Transition Period and Long Term

Impacts would continue to be moderate on a local scale in the period following implementation (approximately 2 to 10 years), as the existing vegetation dies and begins to be replaced with vegetation tolerant of saline conditions. Existing vegetation that would be lost during this phase is predominantly pasture or non-native vegetation, though some areas of forested and scrub-shrub vegetation would likely be impacted in the northwestern portion of the project area. Implementation of this alternative would result in a transition of the existing vegetation communities to predominantly native, tidal wetland vegetation communities.

In the long term (10 to 50 years), Alternative 3 would provide major, local, and regional benefits as vegetation typical of tidal wetlands that would be expected to occur along low-lying areas around the bay are re-established. Re-establishment of tidal vegetation communities would result in increased wetland habitat complexity, connectivity, and availability, providing significant ecological benefits. The County and POTB would develop a maintenance and monitoring plan as a condition of their grants that will include performance standards and adaptive management components for vegetation.

4.6.2 Fish and Wildlife

This section describes fish and wildlife resources in the project area. Additional detail on existing fish and wildlife conditions and the analysis methodology and results may be found in the Biological Resources Technical Memorandum in Appendix G. The evaluation of potential effects on fish and wildlife resources from the proposed alternatives considers changes in tidal hydrology and channel morphology, sedimentation, fish passage, distribution and density, fish use of large wood structures, and macroinvertebrates. This section also includes an evaluation of potential effects on migratory birds. Potential effects on federally and state-listed species are evaluated in Section 4.6.3.

Fish and wildlife resources are protected under several regulations. Additional information on applicable regulations may also be found in Appendix C. The Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) requires that federal agencies consult with the USFWS and NMFS regarding potential impacts on fish and wildlife resources and measures to mitigate these impacts when considering funding or permitting projects that would affect water resources. The Pacific Coast Salmon Fishery Management Plan guides management of salmon fisheries off the coast of Oregon and provides management objectives and allocation provisions for Chinook, coho, and pink salmon. The Migratory Bird Treaty Act of 1918 (MBTA) (16 U.S.C. 703-712) prohibits the take or destruction of migratory bird nests, eggs, and feathers. The Bald and Golden Eagle Protection Act (16 CFR 668) requires measures to prevent the harassment and take of bald eagles resulting from human activities including the alteration of vegetation around a nest.

Habitat for fish and wildlife that is provided by floodplains, wetlands, and other waters of the U.S. is protected through the CWA, EO 11990 – Protection of Wetlands, and EO 11988 – Floodplain Management. These regulations are described in Appendix C, and the potential effects of the action alternatives on those habitats are described in Section 4.5.1 and Section 4.5.2.

The State of Oregon also enforces regulations that protect wetlands and streams and requires projects that propose work in the water to follow in-water work timing guidelines and provide for fish passage. The County and City comprehensive plans identify protection of natural resources, which include fish and wildlife habitats, as important goals.

4.6.2.1 Methodology

Information on existing fish and wildlife use and habitat conditions and likely potential effects from the alternatives on fish and wildlife resources were assessed based on the following:

- Review of existing conditions with respect to habitat quality and quantity based on site-specific field surveys and information from previous studies conducted in the study area
- Review of the observed effects of other similar projects in Oregon, Washington, and California
- Descriptions of existing fish habitat at reference sites (in the vicinity of the project as well as analogous projects) to inform what future habitat conditions may result as a consequence of habitat-restoration activities
- Project-specific studies, including hydraulic modeling conducted by the applicant, to inform expectations of the potential effects on hydrology, sediment transport processes, and habitat alteration

A general field reconnaissance was conducted to further evaluate existing conditions in the study area, and descriptions were confirmed with researchers who are currently conducting ecological monitoring of the SFC study area. The potential impacts of each alternative on fish and wildlife resources were evaluated and are described in the environmental consequences section.

4.6.2.2 Affected Environment

Generally, current conditions within the proposed project area include a diverse mix of terrestrial and aquatic habitat types that provide habitat for a number of fish and wildlife species.

Terrestrial Species

Terrestrial habitats in the study area include mature spruce-dominated riparian forest communities and spruce swamp (Brophy and van de Wetering 2014), managed pasture lands and farms, shrub-scrub and blackberry (*Rubus armeniacus*) hedgerows, and other communities as described in Section 4.6.1. The large mature spruce provide habitat for a wide range of species, including suitable nesting structures for larger bird species such as Bald eagle or for the threatened Marbled murrelet (threatened and endangered species are discussed further in Section 4.6.3). These large trees and forested areas provide shelter for a variety of mammals, and when they fall over into the rivers and sloughs, they provide important habitat structures for invertebrates and fish.

These habitats support a variety of terrestrial wildlife, especially birds. During a field reconnaissance conducted on June 30, 2014, the following migratory and resident bird species were observed: Western wood peewee (*Contopus sordidulus*), Tree swallow (*Tachycineta bicolor*), Red-tailed hawk (*Buteo jamaicensis*), Great blue heron (*Ardea herodias*), American robin (*Turdus migratorius*), Swainson's thrush (*Catharus ustulatus*), Cedar waxwing (*Bombycilla cedrorum*), Turkey vulture (*Cathartes aura*), and Purple martin (*Progne subis*). The fieldwork is described in more detail in the Biological Resources Technical Memorandum in Appendix G. Although not exhaustive, the list indicates a rich diversity of birds potentially occurs within the study area. The study area and Tillamook Bay, in general, are important stop-over and wintering areas for migratory shorebirds, waterfowl, and wide ranging sea birds as well as summer habitat for neotropical passerines and other migratory species (Audubon 2014; Oregon Birding Trail 2014).

Bald eagles have the potential to forage throughout the study area. Although state records for the study area do not show any confirmed Bald eagle nests (ORBIC 2014), local observers have identified an active Bald eagle nest on Hoquarten Slough that is within the area where levees would be removed. USFWS records identified a Bald eagle site along Hall Slough (USFWS 2015c), but it appears that nest tree has blown over in the recent past, and it is unknown if the eagles have an alternate nest site established at this time. Eagles usually have two or more alternate nest sites within a single territory; using different nests in different years. All open water habitats, wetlands, pastures, and estuarine areas within the study area provide suitable foraging opportunities for Bald eagle.

In addition, common mammal species anticipated to occur within the study area include black-tailed deer (*Odocoileus hemionus columbianus*), Roosevelt elk (*Cervus canadensis*), coyote (*Canis latrans*), common gray fox (*Urocon cinereoargenteus*), red fox (*Vulpes vulpes*), bobcat (*Lynx rufus*), and a variety of ground and tree-dwelling mammals, including raccoon (*Proycon lotor*), Pacific jumping mouse (*Zapus trinotatus*), Douglas's squirrel (*Tamiasciurus douglasii*), northern flying squirrel (*Glaucomys sabrinus*), voles (*Microtus* spp.), shrews (*Sorex* spp.), Townsend's mole (*Scapanus townsendii*), western pocket gopher (*Thomomys mazama*), Townsend's chipmunk (*Neotamias townsendii*), striped skunk (*Mephitis mephitis*), western spotted skunk (*Spilogale gracilis*), mink (*Neovision vision*), long-tailed weasel (*Mustela frenata*), beaver (*Castor canadensis*), muskrat (*Odontra zibethicus*), nutria (*Myocastor coypos*), and river otter (*Lutra canadensis*) (Maser et al. 1981; Eder 2002; ODFW 2006; Oregon Forest Resources Institute 2013).

Aquatic Species

Aquatic habitats include marine and brackish tidal creeks, tidally influenced rivers and sloughs, seasonal standing water areas, emergent wetlands, shrub-scrub wetlands, and spruce dominated forest and swamp (Brophy and van de Wetering 2014). Perennial waterways in the project area have been altered with levees, revetments, riprap, tide gates, and sidecast dredge spoils that limit floodplain connectivity. Many of the waterbodies are channelized. Existing agricultural lands are crisscrossed with numerous drainage ditches that direct water through flood control structures out towards Tillamook Bay. Four priority habitats, as identified in the Oregon Conservation Strategy, are present in the study area, including wetlands, estuarine habitats, riparian habitats, and freshwater aquatic habitats (ODFW 2006).

These aquatic habitats are priorities because they provide critical foraging and rearing habitat for critical life stages for many fish species but especially for anadromous fish such as salmon. The estuary wetlands provide a transition zone for adult fish migrating from marine waters up into freshwaters to spawn and again for the young as they adjust from freshwater habitats out to the ocean where they mature. A healthy estuary transition zone is rich in macroinvertebrates that form the base of the food chain for these migratory fish and also for migratory shorebirds. The estuary wetlands support healthy shellfish and crab populations in the bay. Within the study area, these values have been largely lost due to the disconnection of the study area from the influence of the tides and the blockage of channel connections with the adjacent sloughs and rivers.

The existing saline-freshwater interface is complex and affected by tides, rainfall, and season. Downstream portions of the project area may contain salinity levels ranging from 0.1 to 30.1 parts per thousand during the spring to summer period (Ellis 1999). The highest salinity and the largest extent of saline waters within the study area would be expected when incoming river flows from the Wilson and Trask rivers are at their lowest (August and September) and when these low flows correspond with extreme high tides. Water chemistry is important to fish and other regional wildlife in the project vicinity, and the project occurs at the interface where salinity is changing from marine to freshwater.

Aquatic habitats in the study area support a variety of common aquatic and semi-aquatic animal species. Additionally, the greater Tillamook Bay ecosystem is a significant aquatic area that provides habitat for commercially and recreationally important shellfish, myriad invertebrates, game and non-game fish, migratory and resident birds, and marine mammals. Tillamook Bay is essential fish habitat (EFH) for coho salmon (*Oncorhynchus kisutch*), Chinook salmon (*Oncorhynchus tshawytscha)*, Pacific Coast groundfish, and Coastal Pelagics.

Fish species utilizing the project area are varied and seasonal. Ellis (1999) collected a diverse assemblage of marine, freshwater, and estuarine species in the project vicinity, including anadromous species. The Trask, Tillamook, and Wilson rivers contain important salmonid game species, including three species of salmon (*Oncorhyncus* spp.), two species of anadromous trout (*Oncorhyncus* spp.), nongame species such as large-scale sucker (*Catostomus macrocheilus*), three-spine stickleback (*Gasterosteus aculeatus*), lamprey (two species, *Lampetra tridentata* and *Lampetra richardsonii*), multiple species of sculpin (*Cottus* spp.), and resident non-migratory trout (*Oncorhyncus* spp.) (Ellis 1999; NMFS 2008; StreamNet 2014; TEP 2010; Brophy and van de Wetering 2014). The list of fish species in Tillamook Bay, the Trask and Wilson rivers, and Hoquarten Slough is provided in **Table 4.6-2**. Although sampling has not been conducted in Hall Slough, the diversity of fish species would be expected to be similar in the lower reaches of the slough to those described below. The upper reaches of Hall Slough, upstream of Highway 101, are narrow, shallow, and often dry and would not support a diversity of fish species.

Table 4.6-2. Common Fish of Upper Tillamook Bay and Tidal Portions of Rivers within the Study Area

Common Name	Scientific Name
Threespine stickleback	*Gasterosteu aculeatus*
Chinook salmon	*Oncorhynchus tshawytscha*
Coho salmon	*Oncorhynchus kisutch*
Chum salmon	*Oncorhynchus keta*
Steelhead trout	*Oncorhynchus mykiss*
Cutthroat trout	*Oncorhynchus clarki*
Pacific herring	*Clupea pallasii*
Shiner perch	*Cymatogaster aggregata*
Pacific staghorn sculpin	*Leptocottus armatus*
Prickly sculpin	*Cottus asper*
Pacific sanddab	*Citharichthys sordidus*
Starry flounder	*Platichthys stellatus*
English sole	*Parophrys vetulus*
Pacific lamprey	*Entosphenus tridentatus*

Sources: Ellis 1999; NMFS 2014

Macroinvertebrate distribution in the study area is not documented; however, a variety of arthropods, gastropods, ground dwelling annelids, and a great assemblage of species common to the intertidal habitats found along the estuarine edges of the bay are expected in the project area (ODFW 2014d; TEP 2010). The greater Tillamook Bay is an important shellfish harvest area for both commercial and recreational fisheries. Mapped clam beds occur within the central bay and north of the study area. Common target species found in the bay include Dungeness crabs (*Metacarcinus magister*), cockles (*Clinocardium nuttallii*), gaper clams (*Tresus capax*), butter clams (*Saxidomus giganteus*), softshell clams (*Mya arenaria*), and little neck clams (*Leukoma staminea*) (ODFW 2014d; Ainsworth et al. 2014). Tillamook Bay is also home to commercial oyster production. Various studies have identified a multitude of other aquatic invertebrates utilizing bay habitats, particularly closer to the bay mouth and in association with rocky shorelines, riprap, and intertidal zones (Houck et al. 1997).

4.6.2.3 Environmental Consequences

Effects of each alternative were quantified based on the type and extent of project activities and in consideration of the measures to be taken to avoid adverse effects. Comparisons were made among the alternatives to evaluate relative levels of significance. Impacts would be considered significant on fish and wildlife if the alternative would result in measurable changes in abundance or elimination of a species from natural habitat types. Natural habitat types include those that would be expected to be present within the project area in the absence of landscape modifications such as levees or agricultural practices. An impact may also be considered significant if an alternative would result in the permanent loss, reduction, degradation, disturbance, or fragmentation of natural habitats of native species.

For each action alternative, the impact analysis includes summaries of potential short-term (effects occurring during construction; a period of 1 to 2 years), transitional (2 to 10 years, depending on the habitat type and includes the period when fish and wildlife establish and adapt to new physical site and habitat conditions), and long-term (10 to 50 years, the time frame for reaching and sustaining a new dynamic equilibrium or restoration goal) effects.

4.6.2.3.1 No Action Alternative

Construction

Under the No Action Alternative, there would be no construction-related impacts on fish and wildlife.

Transition Period

Agricultural operations (grazing and hay production) would be phased out on the 392 acres in County ownership, and this area gradually would convert to freshwater wetlands. The existing mix of habitat types would remain, including shrub/scrub uplands, emergent wetlands (pasture and non-pasture), shrub/scrub wetlands, and mature Sitka riparian/tidal forested wetlands. The existing proportions of these habitat types would be unlikely to change over time, but the total area would increase as agricultural uses are phased out on the County-owned lands. This would improve habitat conditions for wildlife species that use freshwater wetland habitats; however, these are not the same species that rely on brackish, estuarine, marsh habitats that historically would have used the area. This conversion to freshwater wetlands also would not benefit the ecosystems of the adjacent bay and rivers because the area would remain disconnected hydraulically and ecologically from the surrounding areas by the levees. Therefore, the benefit would be minor and local.

The No Action Alternative would not impact the stands of Sitka spruce in the SFC study area. Over time, the suitability and quality of these stands as habitat may increase as trees continue to mature. It is also possible that areas of alder in the SFC could convert to spruce forest over time, potentially resulting in larger areas of spruce forest. The increased stature of all woody vegetation left undisturbed under the No Action Alternative would result in a gradual succession to species of birds and mammals that prefer older forests with late-successional attributes. However, the area of forested wetlands would be unlikely to expand significantly.

Along with the terrestrial and wetland habitat types, the existing tidal creeks, backwaters, and river channels would remain disconnected from daily tidal flows. Nutrient exchange between tidal floodplains and the estuary would be limited to that which occurs through tide gates. The existing conditions and species mix would remain in place. Successional changes would not be expected as most of the study area is maintained in agricultural uses.

The No Action Alternative would result in continued aggradation of stream and river channels through the accumulation of sediment. The floodplain would remain disconnected from the adjacent rivers and sloughs, and potential rearing habitat for anadromous and migratory fish species would remain limited. Adverse effects to salmon from diking land and restricting tidal flow to historical wetlands have been well documented (David et al. 2014). Under the No Action alternative, restoration of tidal flows and historic estuarine floodplain habitat would not occur. Thus, the adverse growth conditions for juvenile salmon would continue under the No Action Alternative. Climate change factors that may affect stream flows and hydrologic regimes would also continue to limit the ability of anadromous fish populations to adapt and respond resiliently to change (Ward et al. 2015). Additionally, the development and succession of plant communities would continue to occur. Some expansion of willow-dominated shrub/scrub wetlands would occur at current emergent wetlands without grazing pressure, and some closure of waterways through sedimentation would occur over time. This succession would benefit some migratory birds but would continue to degrade the habitats that were historically available to aquatic estuarine species and shorebirds.

The No Action Alternative would maintain the existing adverse conditions for estuary-based fish and wildlife. Therefore, this major effect would be regional in nature and would be considered a significant adverse impact.

4.6.2.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

In contrast to the No Action Alternative, the Proposed Action would result in modification of existing habitats and ultimately would result in a major shift in the fish and wildlife expected to use the project area. Approximately 522 acres of wetlands would be restored in the areas re-opened to tidal influences, and over 14 miles of tidal side channels would be expected to reform.

Construction

Construction of the Proposed Action would result in moderate impacts associated with local disruptions of resident and migratory birds, the potential disturbance and displacement of aquatic organisms, and temporary degradation of water quality in adjacent rivers and other waterways. Most of the construction activities are proposed to occur during the summer of 2016 with in-water work activities primarily limited to the approved in-water work window for the Wilson, Trask and Tillamook rivers (July 1 to September 15). Although a portion of the project area is adjacent to Tillamook Bay, which has a different in-water work window, the riverine work window is considered to be more appropriate for the habitats and life stages that would be expected to occur within the project area. This also allows construction activities to occur when the project area is the driest, which limits the potential for impacts from sedimentation and erosion. The approved in-water work window limits in-water activities to those periods when there are the fewest migratory fish present, or the life stages present are less sensitive to in-water construction impacts. The applicant proposes to request a variance to the work window for an extension that would allow work to continue to October 31 in 2016 and September 30 in 2017.

Construction activities would result in short-term displacement of terrestrial wildlife. Tree and shrub removal and grading (associated with the removal of old levees and construction of new levees) have the potential to impact nesting birds and would require implementation of BMPs and mitigation measures described in Section 6 to avoid these impacts. Compliance with the MBTA would include seasonal restrictions on work activities, particularly tree removal, to periods when birds are unlikely to be nesting.

As described in Section 4.5.1, the Proposed Action would remove trees growing along the tops of existing levees that would be removed (see Section 4.6.1.3.2 for more details) and reuse some of them on site as large woody debris. Large woody debris provides short- and long-term habitat benefits for a variety of fish and wildlife, depending on where in the floodplain the wood is located. Habitat trees or logs typically include the root wad and about 20 to 30 feet of the tree trunk. If possible, some branches also would be retained. However, the bigger the root wad or the presence of branches, the more difficult it is to transport, handle, and place the trees. Under the Proposed Action, the habitat trees would be pushed into the ground and would not be anchored by piling or other engineered means.

It is not known at this time how many trees will be salvageable or suitable for reuse as habitat logs. Some of the trees would be reserved for use in offsite restoration projects, with approximately 40 trees proposed for use by ODFW at a proposed restoration site along Beaver Creek in 2016 (Levesque 2015). Additional trees that are suitable for reuse in other restoration projects may be stockpiled for up to 2 years although additional potential projects have not been identified at this time. The reuse of logs for habitat structures on and off site would provide moderate, regional, benefits for fish and wildlife habitat.

Local observers have identified an active eagle nest on Hoquarten Slough near the Sadri property. The current design would not remove this nest tree although there would be a permanent alteration of the vegetation within 660 feet of the nest. If the nest tree is occupied during construction, then there would be the potential for construction activity and noise to disturb the nest occupants, and a 660-foot buffer would be required around the nest tree where heavy equipment would not be operated during the nesting season (USFWS 2015d). Regardless of whether the nest is active or inactive during the construction season, a permit for disturbance of Bald eagles and their nesting habitat under the Bald and Golden Eagle Protection Act would be required. Foraging use of the project area by Bald eagles is not expected to measurably change although populations of fish and waterfowl prey species are expected to increase, which would increase foraging opportunities for eagles.

The removal of vegetation, heavy equipment operation, and in-water work would all have the potential to temporarily impact water quality in waters adjoining the project area, which could be detrimental to aquatic organisms in this area. In-water work, such as the filling of ditches and riprap removal below the high tide line, would require work area isolation and removal of fish from the work zone and has the potential for fish handling, which can result in inadvertent mortality of local and migratory fish and other aquatic organisms. Work area isolation methods may include the use of silt curtains or other appropriate measures. Permits would be required for in-water work from USACE and ODEQ. These regulatory agencies are required to ensure that in-water work does not result in a degradation of water quality or impacts on aquatic life. The project would be designed to prevent fish stranding and to allow fish passage through tide gates in compliance with state and federal regulations and the PROJECTS design criteria.

Transition Period

The Proposed Action would result in restoration of approximately 522 acres of historic tidal wetlands and 14 miles of off-channel habitat. This would shift the existing species composition in the project area. The species found in the primary waterways surrounding the project area would remain relatively unaltered, but expansion of floodplain connectivity and reconnection of side channels along these waterways would provide increased aquatic cover and habitat complexity.

The conversion of existing uplands and freshwater wetlands to tidally influenced saline and brackish water wetlands and estuarine habitats would have a temporal component because the decomposition of existing vegetation and the colonization by saline tolerant plant species would take years (Zedler and Callaway 1999; NHC 2011). Fish use of newly accessible aquatic habitats for forage, cover, and high water refuge would occur with initial inundation. During the conversion period, use by freshwater and marine-associated fish and wildlife species would be immediate, but the highest and most diverse use would occur after complete conversion and decomposition of existing vegetative material.

Over time, the low-lying wetlands and upland habitats would lose much of their existing woody plant species that are intolerant of saline or brackish water as tidal fluctuations are restored to the project area. These freshwater wetlands and riparian shrub communities would convert to a mixture of tidal wetland habitat types. The minimum timeline for full functional replacement is expected to be 5 to 10 years for emergent tidal wetlands (Zedler and Callaway 1999). Die back of trees and shrubs would result in an initial increase in woody debris locally and in Tillamook Bay as there would be an influx of deadfall, snags, and other woody material. Increased woody material into local waterways and estuarine habitats would provide improved habitat for migratory and resident fish populations.

Along with these changes would be a large initial expansion of tidal low marsh and mud flat habitats. Creation of mud flats and low tidal marsh likely would accompany colonization by some bay-associated invertebrates, depending on salinity and sediment dynamics. As the mudflats are colonized by invertebrates, they also may be expected to attract large numbers of migratory shorebirds. Colonization and species mixes likely would be temporally dynamic as sediment accumulation and decomposition of existing vegetation and organic material progresses and shifts over time.

As sediment accumulates within the lower elevations of the project area, the area gradually would convert to high marsh (Zedler and Callaway 1999; NHC 2011). With these habitat conversions, there would be alterations in the fish and wildlife species mix, inclusive of macroinvertebrates. Additionally, forage quality and type for all levels of biota would change throughout the transition period.

Tidal creek restoration through natural processes and reconnection of relict channels to tidal fluctuation would offer improved aquatic refuge for juvenile salmonids, forage fish, juvenile marine fish, and resident bay fish species. Shorebird and wading bird use of wetlands and channels within the project area would increase over time, and major increases in foraging opportunities for migratory and wintering waterfowl would be expected.

While the number and diversity of shorebirds, such as Dunlin (*Calidris alpine*) and yellowlegs (*Tringa* sp.), likely would increase, birds more closely associated with freshwater wetlands, such as Mallard (*Anas platyrhynchos*) and Wood duck (*Aix sponsa*), may decrease in number. However, many of the birds that are observed regularly in the SFC project area (as reported on ebird.org), such as Virginia rail (*Rallus limicola*), Sora (*Porzana carolina*), and Great blue heron, would continue to be found, as many of the bird species currently present utilize both estuarine and freshwater wetland habitats.

Although total use by upland-associated birds and other upland wildlife species would decline as vegetation and forage opportunities shift to a more marine and tidally influenced system, freshwater wetlands and riparian habitat would still exist toward the upstream reaches of the project area. These areas would continue to attract a diverse assemblage of birds.

Productivity in the Tillamook Bay ecosystem as a whole would increase with an expansion in estuarine habitat. Increasing estuarine habitat would lead to increased fish, bird, and invertebrate abundance and increases in habitat and foraging opportunities.

Long Term

The Proposed Action is expected to substantially benefit five target salmonid fish stocks identified by ODFW, including Oregon coast chum salmon, Oregon Coast coho salmon, coastal cutthroat trout, and fall and spring stocks of Oregon Coast Chinook salmon. The benefits to these stocks include provision of additional estuarine rearing habitat where it is currently limited and additional foraging opportunities (NMFS 2008; NMFS 2013b). The Proposed Action would have the potential to improve salmonid resiliency to climate change and climatic variability with increased floodplain connectivity (Ward et al. 2015). NMFS and ODFW have identified additional non-salmonid stocks that would receive benefits from the Proposed Action, including winter steelhead, Pacific lamprey, staghorn sculpin, white sturgeon, top smelt, three-spine stickleback, shiner perch, English sole, and starry flounder (NMFS 2013b). These species would benefit from an improved food chain, a net increase in aquatic habitats, and improved water quality and ecological function. Important shellfish populations would benefit from improved water quality and increased ecosystem productivity.

The loss of freshwater habitats, including the seasonally wet ditches and the tide gate controlled freshwater segments of Blind Slough, would result in a species shift from freshwater species of macroinvertebrates and fish to saline or brackish water tolerant species. This conversion to more saline waters in the project area could cause the local loss of some amphibian and freshwater fish species. Use and presence by most mammals probably would decrease as the converted habitats are expected to be wetter than the existing condition. The existing freshwater systems do not represent the natural habitat types that would be expected in low-lying areas along the bay. Therefore, the conversion of these freshwater types to saltwater habitats would not be considered significant even though it does represent a major change from existing conditions.

There would be a steep salinity gradient across the site, with the shift from marine salinity levels to freshwater expected to occur over less than 1 mile. This makes it difficult to predict where the salinity changes will occur across the site and thus where habitat conversions will be expressed. Some portions of the site, particularly in the eastern side, may be expected to remain freshwater dominated, which would be consistent with the natural conditions. While the ultimate area of habitat conversion is difficult to quantify on areal and temporal scales, the overall habitat complexity, connectivity, and availability to fish, birds, and macroinvertebrate use would increase. The Proposed Action would result in a major beneficial effect compared to the No Action Alternative.

Summary of Effects

Construction of the Proposed Action could result in moderate, local, adverse impacts on fish and wildlife.. Implementation of mitigation measures and BMPs described in Section 6 would be required to avoid or reduce construction-related impacts on migratory birds, aquatic species and habitats, fish passage, turbidity, and other water quality parameters. To comply with the MBTA, all project activities that have the potential to disturb or remove woody vegetation or include substantial removal of herbaceous vegetation during grubbing and clearing would be conducted outside of active nesting periods for migratory birds to the extent possible, or nesting bird surveys would be conducted prior to tree removal to ensure active bird nests are not disturbed. In-water work, entailing the installation of work area isolation devices or structures, would require fish salvage measures, and a fish salvage permit would be required by ODFW and NMFS. In addition, all activities that include installation or replacement of over water structures, including temporary or permanent bridges, tide gates, culverts, or fishways, would require the approval of a fish passage plan by ODFW (ODFW 2014c). Fish passage plans must meet certain standards and design guidelines and require review by an ODFW fish passage biologist. In accordance with PROJECTS design criteria for projects involving tide gates, the project designs must also be reviewed and approved by a NOAA fish passage engineer. Other measures would be required to minimize water quality effects such as turbidity during construction. These mitigation measures are described in Section 6.

With implementation of the BMPs and mitigation measures, adverse construction-related impacts would be less than significant. Within the transition period, the Proposed Action would result in moderate, local and regional, beneficial effects as natural habitat types are restored and habitat area and connectivity increases. During the transition period there may be some continuing environmental effects from erosion and nutrient flux, but benefits would be provided by increasing forage and cover resources and opportunities. Over the long term, the Proposed Action would result in major, local and regional, beneficial effects on fish and wildlife.

4.6.2.3.3 Alternative 2: Hall Slough Alternative

Construction

Construction activities associated with the Hall Slough Alternative would include dredging to widen and deepen the slough and construction on the banks to set back the existing levees where feasible. Construction would remove existing riparian vegetation, which could result in local impacts to nesting birds and harassment of terrestrial and aquatic species. However, because the affected area is narrow and linear, and much of it is in active agricultural uses, existing wildlife use is limited. In-water work could require the installation of isolation measures and may require fish salvage to remove fish from the work area, and this handling could result in mortality of individuals. The slough upstream of Highway 101 is currently narrow, shallow, and often dry and would not support much fish use under existing conditions. Construction impacts would be moderate, local, and short-term and, with the use of BMPs, adverse effects would not be significant.

While the PROJECTS consultation would not apply to the Hall Slough Alternative, the conservation measures described in PROJECTS (NMFS 2013a) provide guidance for appropriate methods to conduct work related to levee setbacks, floodgate construction, and wetland restoration. These measures would be applied where applicable to reduce potential impacts to the extent practicable. In-water work would require fish salvage measures, and a fish salvage permit would be required by ODFW and NMFS.

To comply with the MBTA, all project activities that have the potential to remove woody riparian vegetation or include substantial removal of herbaceous vegetation during grubbing and clearing would be conducted outside of active nesting periods for migratory birds, to the extent possible, or nesting bird surveys would be conducted prior to tree removal to ensure active bird nests are not disturbed. Other measures would be required to minimize water quality effects, such as turbidity, during construction. These mitigation measures are described in Section 6.

Transition Period and Long Term

Under the Hall Slough Alternative, the slough likely would require periodic dredging to maintain the design channel width and depth. The frequency of dredging would depend on the rate of sediment accumulation, but it could be as frequent as every 2 to 5 years based on historical records for maintenance dredging in nearby sloughs and waterways. Periodic maintenance dredging would affect fish and wildlife through in-water work that could result in increased turbidity, noise and activity from construction equipment that likely would be barge mounted, and disturbance of riparian vegetation. Potential direct effects to fish and other aquatic species may include behavioral changes associated with short-term and localized increases in turbidity and short-term reductions in benthic invertebrate production. In-water work for the Hall Slough Alternative, including periodic maintenance dredging, would only occur during the preferred ODFW in-water work window. It is anticipated there would be some periodic disturbance of the riparian vegetation although it is unlikely the disturbance during maintenance would be as extensive as during the initial construction. This periodic maintenance dredging would have the potential for minor, local, short-term, adverse impacts on fish and wildlife, which would not be significant with the use of appropriate BMPs and compliance with state and federal regulations regarding in-water work.

The Hall Slough Alternative would reestablish a connection to the Wilson River at the upper end of Hall Slough and would deepen and widen the slough, creating better aquatic connectivity along its length. Anticipated changes in fish and wildlife habitat and species composition would not differ much from the No Action Alternative, with the exception of the restoration of approximately 90 acres of riverine flow-through wetlands along the banks of Hall Slough. Alternative 2 would not be expected to result in more than a minor shift in the distance upstream that tidal fluctuations are observed up Hall Slough.

Under the Hall Slough Alternative, much of the study area would no longer be used for agriculture. Agricultural operations (grazing and hay production) would be phased out on the 392 acres in County ownership, and this area would convert gradually to freshwater wetlands. As described in Section 4.6.1.3.3, this area would be expected to develop areas of scrub/shrub and forested wetlands, which could provide improved conditions for wildlife that use forested and freshwater wetland systems. Forested habitats are not uncommon in the region although forested bottomland habitats are rarer. However, there would not be any benefits for species that rely on estuarine systems and only minor benefits for fish species. The SFC area would not be restored to historical tidal wetland conditions, and off-channel habitats would not be reconnected to the main channels. The conversion of the County-owned lands from agricultural uses to freshwater wetlands would provide minor, local, beneficial effects for fish and wildlife.

While it is anticipated there would be increased fish use of Hall Slough for migration, rearing, and foraging as a result of the improved connectivity, the Hall Slough Alternative would not substantially improve the availability of estuarine or aquatic habitats in contrast to the No Action Alternative. The availability of tidally influenced lands would remain constrained by existing levees and other barriers to tidal influence downstream of the Hall Slough construction area.

Summary of Effects

The Hall Slough Alternative would result in moderate local impacts on fish and wildlife during the construction phase, including initial dredging. Implementation of mitigation measures and BMPs described in Section 6 would avoid or reduce these construction-related impacts to fish and wildlife such that they are less than significant.

Within the transition period Alternative 2 would result in moderate, local, beneficial effects from increased forage and cover resources and opportunities along Hall Slough, including the aquatic reconnection of the slough to the Wilson River. Over the long term, the Hall Slough Alternative would result in moderate, local and regional, beneficial effects on fish and wildlife from increased ecosystem connectivity and improved aquatic habitat function although short-term, minor, local aquatic disturbances would occur in perpetuity from periodic maintenance dredging.

4.6.2.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction

Construction of Alternative 3 would result in similar construction-related impacts as those described under the Proposed Action. Construction activities have the potential to result in moderate, local, short-term impacts on fish and wildlife from vegetation removal, heavy equipment use, and in-water work. In-water work can result in impacts to aquatic organisms and fish from increases in turbidity and from fish exclusion protocols.

Transition Period and Long Term

Alternative 3 would increase restored tidal wetland habitat by approximately 568 acres. This habitat restoration would result from the removal of levees and tide gates that prevent the tides from inundating the project area. The restoration of tidal wetlands and side channel habitat would significantly increase the aquatic habitat present in the project area. In contrast to the No Action Alternative, Alternative 3 would ultimately shift the aquatic and terrestrial mix of fish and wildlife from freshwater-associated species to saline and brackish tolerant species. Under Alternative 3, Blind Slough would be re-connected to the Wilson River, and other tidal creeks and sloughs would form or reestablish side channel habitats, providing an increase in instream and tidally influenced refuge, shelter, and foraging opportunities for a diverse range of estuarine, anadromous, and marine fish species and shorebirds.

Alternative 3 would have similar effects on freshwater amphibians and fish species as described for the Proposed Action because the activities would be similar. Tillamook Bay productivity and aquatic habitats would be expected to increase with Alternative 3 in contrast with the No Action Alternative. The increase in aquatic habitats and the expansion of forage, cover, and rearing areas for bay inhabitants, including fish, birds, and macroinvertebrates, would influence the food web and ecosystem.

Summary of Effects

Construction of Alternative 3 could result in moderate local impacts to fish and wildlife. Implementation of mitigation measures, including those in PROJECTS (NMFS 2013a) and BMPs described in Section 6 would be required to avoid or reduce impacts on migratory birds, aquatic species and habitats, fish passage, turbidity, and other water quality parameters. Overall, this alternative would result in increased wetland habitat complexity and availability, providing significant ecological benefits, including development of low and high tidal marsh habitats. With implementation of the BMPs and mitigation measures, adverse construction-related impacts would be less than significant. During the transition period, Alternative 3 would result in moderate, local and regional, beneficial effects, with some adverse effects from erosion and nutrient flux, but benefits would be provided by increasing forage and cover resources and opportunities. Over the long term, Alternative 3 would result in major, local and regional, beneficial effects on fish and wildlife.

4.6.3 Threatened and Endangered Species and Critical Habitat

Special-status species include federally threatened, endangered, proposed, and/or candidate plant or wildlife species; federal species of concern; state threatened, endangered, and proposed wildlife species; state sensitive animals; and state threatened, endangered, and candidate plants. Federally designated species are managed by USFWS and NMFS while state-listed species are managed by ODFW (fish and wildlife) and by ODA (plants). Designated critical habitat for federal threatened and endangered species that occurs within the project area is also identified in this section. Additional detail on existing threatened and endangered species that may occur in the project area and the analysis methodology and results may be found in the Biological Resources Technical Memorandum in Appendix G.

Special status species are protected under several regulations. Additional information on applicable regulations may also be found in Appendix C. The Endangered Species Act (42 U.S.C. 1531-1544) provides guidance for the protection of federally listed species and the ecosystems on which they depend. Section 7 of the federal ESA (16 U.S.C. 1536) requires federal agencies to consult with USFWS or NMFS, as appropriate, to ensure actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of threatened or endangered species or result in the destruction or adverse modification of designated critical habitat. The Magnuson-Stevens Fisheries Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.), designates EFH for certain commercially managed marine and anadromous fish species and is intended to protect habitat of commercially managed fish species, including anadromous fish species, from being lost because of disturbance and degradation. The Marine Mammal Protection Act (MMPA) (16 U.S.C. 1361 et seq.) prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas and the importation of marine mammals and marine mammal products into the U.S. In Oregon, the Oregon Endangered Species Act (ORS 496 et seq.) requires consultation with ODA on potential impacts to listed plant species.

4.6.3.1 Methodology

The methodology for assessing potential impacts on listed species followed the same steps described in Section 4.6.2.1, including review of information from existing data sources, a field reconnaissance, and coordination with researchers currently conducting ecological monitoring of the SFC study area. Additional information reviewed, relevant to the evaluation of effects on listed species, included the following:

- Review of information on the occurrence of special status species and designated critical habitat from USFWS (2014b) and NMFS (2008)
- Review of relevant information on the life history, limiting factors, and threats to listed species that have potential to occur in or near the study area and information on designated critical habitat, including the Primary Constituent Elements (PCEs) present or likely to be present within the study area

4.6.3.2 Affected Environment

USFWS indicates there is the potential for 10 threatened or endangered plant and animal species to occur within Tillamook County as well as one candidate species and numerous unlisted species of concern (**Table 4.6-3**). Listed and candidate species include four birds, one plant, one insect, four reptiles (sea turtles), and one mammal. Additionally, the NMFS-administered and federally listed Oregon Coast coho ESU is known to occur within the study area and is one of several species targeted by restoration objectives of the Proposed Action (NMFS 2013a). Many of the marine species under NMFS jurisdiction, including most sea turtles and cetaceans (whales), are not expected to occur within the study area and are not included in this analysis. Seals and sea lions are known to occur in the project area and may use the adjacent waterways in their pursuit of salmon and other fish.

Oregon Coast coho are listed as threatened under the ESA. NMFS is currently drafting a Recovery Plan for Oregon Coast coho, which includes a plan for Tillamook basin. Oregon Coast coho populations have been severely impacted by the loss of off-channel rearing habitat in tidal and freshwater sloughs and oxbows across the Oregon coast (TBNEP 1998a). Almost 90 percent of the Tillamook Bay estuary tidal wetlands have been lost to agricultural and urban/residential development (Tillamook County 2013). The current coho population in the Bay is estimated to represent only about 1 percent of historic levels (Tillamook County 2013). Lack of available tidal wetland rearing habitat limits the potential for recovery of coho both within Tillamook Bay and across their entire Oregon Coast ESU.

Aquatic habitats associated with the rivers, streams, sloughs, and Tillamook Bay within the study area are designated critical habitat for the Oregon Coast coho ESU (NMFS 2008). PCEs include freshwater rearing sites, freshwater migration corridors, estuarine areas, and nearshore marine areas (NMFS 2008). All named waterways (Wilson River, Tillamook River, Trask River, Hall Slough, Dougherty Slough, and Hoquarten Slough) except Blind Slough are recognized as rearing and migration corridors for the species by StreamNet (2014). The study area is a transitional habitat for rearing juvenile coho salmon prior to their migration to marine habitats (Miller and Sadro 2003). The tidally influenced portion of the study area may contain juvenile coho for many weeks each year, given the occurrence of the project at the salt and freshwater interface (Miller and Sadro 2003). Brophy and van de Wetering (2014) found juvenile coho within the study area and adjoining aquatic sites from March through August, with the highest abundances during April, May, and June. Additionally, adult coho migrating to spawning grounds in upstream segments of the Wilson, Tillamook, and Trask rivers must pass by the study area during the fall migration (StreamNet 2014).

Table 4.6-3. Special Status Wildlife Species Potentially Occurring in Tillamook County

Scientific Name	Common Name	Federal Status [2]	State Status	ORBIC [1] Record	Preferred Habitat	Suitable Habitat Potentially Present?
Oncorhynchus kisutch	Coho salmon	T	T	Record	Migratory between marine and freshwater; reproduction and juvenile rearing in freshwater; adult life state in marine	Yes
Acipenser medirostris	Southern DPS Green Sturgeon	T		No	Anadromous with regular use of estuarine habitats for forage	Yes
Speyeria zerene	Oregon silverspot butterfly	T	T	Record outside of study area	Coastal prairie or meadow	No
Pelecanus occidentalis califronicus	California brown pelican		E	Record	Marine and estuarine waters	Yes
Charadrius alexanrinus nivosus	Western snowy plover	T	T	Record outside of study area	Beaches, ocean shore	No
Brachyranpus marmoratus	Marbled murrelet	T	T	No	Conifer-dominated forest stands that generally are 80 years old or older and/or have trees greater than or equal to 18 inches mean diameter at breast height (dbh) with suitable nesting structure and within 50 miles of the Coast	Yes
Stix occidentalis caurina	Northern spotted owl	T	T	No	For nesting pairs, typically 40 to 60 percent nesting, roosting, foraging (late-successional/old-growth forest) in a home of approximately 4,000 acres	No
Phoebastria albatrus	Short-tailed albatross	E	E	No	Marine waters	No

Scientific Name	Common Name	Federal Status [2]	State Status	ORBIC [1] Record	Preferred Habitat	Suitable Habitat Potentially Present?
Arorimus longicaudus	Red tree vole (Northern Oregon Coast DPS)	Candidate		No	Sitka spruce and hemlock forests	No

1 - Source: ORBIC 2014

2 - E = Endangered

T = Threatened

The southern distinct population segment (DPS) of North American green sturgeon (federally threatened) is known to occur within Tillamook Bay (NMFS 2009) and is anticipated to occur in the waterways adjacent to the study area. While designated critical habitat for this species excludes Tillamook Bay (NMFS 2009), the occurrence of this species in the bay necessitates consideration of effects to this species.

Potential nesting habitat also exists within the study area for the threatened Marbled murrelet (*Brachyramphus marmoratus*) (USFWS 2015c). The occurrence and frequency of use of these habitats by Marbled murrelets are unknown as no audio-visual surveys to determine species' presence were conducted prior to the project review by the USFWS. In the absence of two sequential years of Marbled murrelet surveys following approved interagency protocols for detecting murrelets, the study area is assumed to be occupied by the species. USFWS wildlife biologists made site-specific determinations on the presence of potential murrelet nesting structures within the study area.

Generally, conifer trees over 107 feet tall with a diameter of at least 19.1 inches and large branch platforms at least 32 feet above the ground and adjacent to other trees are considered potentially suitable nesting habitat for this species (Burger 2002; Nelson and Wilson 2002; USFWS 1997, 2003b, 2015c). Forest stands and patches containing trees meeting these criteria occur within the study area. The locations of 43 Sitka spruce trees, which have suitable nesting habitat characteristics within the footprint of levees planned for removal, were recorded using Global Position System (GPS) by USFWS biologists in 2014. Additional trees with potential suitable nesting habitat structures are located within the interior of the forested portions of the project site but are not proposed for removal under any of the alternatives. The forested areas are assumed to provide murrelet habitat due to presence of trees of sufficient size and structure that could potentially support nesting murrelets (USFWS 2015b). All of the major forested areas along the Wilson River and Hoquarten Slough potentially contain trees that would provide suitable nesting structure for murrelets.

The Oregon silverspot butterfly prefers coastal prairie and meadow habitat. Suitable habitats in Oregon include coastal terraces and headland meadows with salt spray and montane grasslands such as occur at Mount Hebo. Larval host plants, blue violets (*Viola adunca*) must be present. No suitable habitat is present within the study area, nor is the study area within any of the known sites for Oregon silverspot butterfly (USFWS 2015b).

The Western snowy plover nests along the ocean shore on sandy beaches, sand flats, and sandy dunes. Lauten and others (2014) conduct annual nesting surveys, and the study area is not recognized as potential habitat in their annual monitoring. The study area is not along the ocean shore where sandy habitats occur, and the Western snowy plover is not anticipated to occur in the study area.

The ORBIC database contains records for California brown pelican (*Pelecanus occidentalis califronicus* – state endangered) within the project area (ORBIC 2014). Open water foraging areas are available within all of the tidal waterways surrounding the study area for California brown pelican. All open waters of Tillamook Bay downstream of the study area also could be considered suitable for California brown pelican foraging and stopover use. California brown pelicans had once been federally listed due to sharp declines in their population. Although the population has rebounded and the species has been delisted, it remains a state-listed species and is vulnerable to declines in prey species.

The eastern stock of Steller sea lion has been delisted but is still afforded protection under the MMPA. Steller sea lion forage near shore and in ocean waters and use terrestrial habitats as haul-out sites for periods of rest and molting and as rookeries for mating and pupping during the breeding season (Columbia River Crossing 2010; NMFS 2008; ODFW 2011). Haul outs and rookeries usually consist of beaches (gravel, rocky, or sand), ledges, and rocky reefs. Hundreds of Steller sea lions breed at Three Arch Rocks near Oceanside, Oregon (Ocean Policy Advisory Council 1993). The closest designated critical habitat is at Long Brown and Seal Rocks near Port Orford, Oregon. Steller sea lions occasionally enter Tillamook Bay; however, foraging habitat, haul-out sites, and rookeries are not present, and they are not known to travel to the tributaries adjacent to the project area at the south end of the bay.

Harbor seals also are protected under the MMPA. Harbor seals are known to seek refuge and produce pups in Tillamook Bay and haul out in large numbers in the northern upper half of the bay (Brown and Mate 1983; Ocean Policy Advisory Council 1993). There may be occasional use of tributary habitats near the project area by a few harbor seals for foraging (Wright et al. 2007; Wright 2015).

Special status plant species include federal- and state-listed threatened, endangered, candidate species, and species of concern. Species that potentially occur in Tillamook County are shown in **Table 4.6-4**, with an indication of the potential for suitable habitat to occur in the study area. The USFWS, which is responsible for protection of federally listed plants, has indicated that threatened or endangered plant species are not present in the project area; therefore, protocol surveys for rare plants would not be required (USFWS 2015c).

Estuarine habitats within the project area are EFH for coho salmon (*Oncorhynchus kisutch*) and Chinook salmon (*Oncorhynchus tshawytscha)* (NMFS 2014). The project area is also EFH for Pacific Coast groundfish (NMFS 2014). Groundfish likely to be found in the project area include starry flounder (*Platichtyhys stellatus*) and Pacific sanddab (*Citharichthys sordidus*) (Ellis 1999). Finally, Tillamook Bay is also EFH for Coastal Pelagics, including Northern anchovy (*Engraulis mordax*) (Pacific Fishery Management Council [PFMC] 1998), which have been found in the study area (Ellis 1999).

4.6.3.3 Environmental Consequences

Effects of each alternative were quantified based on the type and extent of project activities and in consideration of the measures to be taken to avoid adverse effects. Comparisons were made among the alternatives to evaluate relative levels of significance. Impacts would be considered significant for each listed species if the alternative would result in measurable changes in the local or regional abundance or health of the plant or animal population. In addition, impacts would be considered significant on designated critical habitat if the alternative would result in changes or alterations to this habitat that prevents its occupation or use by the associated species, when it has substantial value for breeding and rearing.

For each action alternative, the impact analysis includes summaries of potential short-term (effects occurring during construction; a period of 1 to 2 years), transitional (2 to 10 years, depending on the resource; the period when plants, fish, and wildlife establish and adapt to new physical site and habitat conditions), and long-term effects (10 to 50 years, depending on the time frame for reaching and sustaining a new dynamic equilibrium or restoration goal).

Table 4.6-4. Special Status Plant Species Potentially Occurring in Tillamook County

Scientific Name	Common Name	Federal Status	State Status	ORBIC Record	Preferred Habitat	Elevation	Suitable Habitat Potentially Present?
Abronia umbellata ssp. *breviflora*	Pink sandverbena	SOC	E	No record	Coastal dunes and disturbed sandy areas in coastal scrub	At or near sea level	No
Anemone oregana var. *felix*	Bog anemone	SOC		No record	Sphagnum bogs and marshes	10-325 feet (ft), 2000-3000 ft	No
Cardamine pattersonii	Saddle Mt. bittercress	SOC	C	No record	Grass balds, moist cliffs, rock crevices, moss mats over bedrock; in gravel along streams in forest	2,690-3150 ft	No
Chloropyron maritimum ssp. *palustre*	Pt. Reyes bird's-beak	SOC	E	No record	Inhabits the upper end of maritime salt marshes at approximately 2.3-2.6 m (7.5-8.5 ft) above Mean Lower Low Water in sandy substrates with soil salinity 34-55 parts per thousand, and less than 30 percent bare soil in summer	0-10 ft	No
Dodecatheon austrofrigidum	Frigid shootingstar	SOC		No record	At high elevations on basalt cliffs near streams and waterfalls, sometimes on rotting wood; at low elevations, basalt rock crevices in major rivers, below high water line	100-4,000 ft	No
Erythronium elegans	Coast Range fawn-lily	SOC	T	No record	Open sites on rocky slopes and cliffs; edges of sphagnum bogs; mountain bogs, meadows, and rocky balds	2,690-3,350 ft	No
Filipendula occidentalis	Queen-of-the-forest	SOC	C	Historic (1937) – location uncertain	Shady damp sites; on river banks, in rock crevices and seeps just above high water level; damp salmonberry shrublands; on Onion Peak on rock cliffs in remnant stands of Abies and Tsuga; moist areas in full sun or partial shade	0-3,120 ft	Yes

Scientific Name	Common Name	Federal Status	State Status	ORBIC Record	Preferred Habitat	Elevation	Suitable Habitat Potentially Present?
Micranthes hitchcockiana	Saddle Mt. saxifrage	SOC	C	No record	Grassy balds, thin, rocky soils, and rock crevices	2,200-3,350 ft	No
Montia howellii	Howell's montia		C	No record	Moist lowland areas	NA	Yes
Sidalcea hendersonii	Henderson's sidalcea	SOC		No record	Coastal bog, fen, and wetland	NA	Yes
Sidalcea hirtipes	Bristly-stemmed sidalcea	SOC	C	2 miles east of project	Open meadows, grasslands, balds, coastal bluffs, and mountain peaks	0-1,800 ft, 4,800-10,900 ft	No
Sidalcea nelsoniana	Nelson's sidalcea	T	T	No record	Relatively open areas on damp soil, in meadows, wet prairie remnants, fencerows, roadsides, deciduous forest edges, and occasionally Oregon ash wetlands	150-2,000 ft	No
Silene douglasii var. *oraria*	Cascade Head catchfly	SOC	T	No record	Coastal bluffs	500-600 ft	No

Source: ORBIC 2014
C = Candidate
E = Endangered
T = Threatened
SOC = species of concern

All project activities associated with the action alternatives must comply with the ESA. The coordination and consultation process on potential impacts on federally listed species is described in Section 7 of this EIS.

4.6.3.3.1 No Action Alternative

Construction

Under the No Action Alternative, there would be no construction or construction-related impacts on special status species.

Transition Period and Long Term

Although there would be a shift from agricultural uses to freshwater wetlands over much of the project area, habitats that may currently support federally listed species, primarily Marbled murrelet and Oregon Coast coho, would be unaltered by project activities. Habitats utilized by green sturgeon would remain unchanged. There would be no improvement in designated critical habitat for Oregon Coast coho salmon in the study area. The PCEs for coho critical habitat, including freshwater rearing, estuarine and riverine migration, and rearing corridors for coho, would remain unchanged. The existing habitat for coho has been degraded by channelization, armoring of the banks of the waterways, and the blockage of side channel connections to the main rivers and sloughs. The loss of tidal wetlands has reduced the available rearing habitat for coho. The limited availability of juvenile salmonid rearing habitat would remain a constraining factor on system productivity for this group of target species, including the federally threatened Oregon Coast coho ESU (NOAA 2013).

Large diameter Sitka spruce trees would remain intact, and potential nesting habitat for Marbled murrelet may improve, but trees could be lost naturally through winter storms, flood inundation, and death.

The No Action Alternative would maintain the existing adverse conditions for estuary-based special status species. This would be considered a moderate, regional, adverse impact that would be significant over the long term.

4.6.3.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Potential Effects on Aquatic Species

Construction

PROJECTS, pursuant to Section 7(a)(2) of the ESA, applies to aquatic restoration funded or carried out by USFWS and NOAA under the Proposed Action (NMFS 2013a). PROJECTS provides coverage for potential effects on Oregon Coast coho, critical habitat for Oregon Coast coho, EFH, eulachon, and green sturgeon. This restoration opinion would apply to the Proposed Action, and compliance with the terms and conditions and other design criteria in it would be required for the project to be in compliance with ESA and MSA.

Construction of the Proposed Action would result in moderate, local impacts on Oregon Coast coho salmon from in-water work, fish handling procedures, and temporal loss of aquatic habitats over the short term. Project actions would include substantial earthwork and the use of heavy equipment in proximity to waterways potentially containing listed salmon. Inadvertent discharge of sediment, equipment fluids, and other construction-related waste could result in temporary detrimental impacts on water quality and aquatic habitats. The risk of sediment discharge and increased turbidity would be greatest during activities that are conducted directly in the water, including ditch filling, connection of new channels to existing waterways, and riprap removal below the high tide line. These activities would require the implementation of measures to isolate the work area and minimize the potential for turbidity impacts on water quality. Tree removal and mortality would result in a loss of shade over waterways, which may increase water temperatures, particularly along Hall and Hoquarten sloughs. Construction-related impacts on water quality would be moderate and local due to the large amount of earthwork proposed. However, with the implementation of BMPs and mitigation measures described in Section 6 to protect fish and water quality during construction, these adverse impacts would not be significant.

The potential for fish stranding during project construction would be limited by adherence to work isolation BMPs. These include careful diversion of flows around work areas with installation of cofferdams and bypass culverts, careful project staging, and deployment of comprehensive barriers between waters and work areas during the duration of work. Adherence to construction BMPs would result in a negligible potential for fish to become stranded.

Construction activities are proposed to occur during the summer of 2016, with in-water work activities primarily limited to the ODFW preferred in-water work window for the riverine portions of the Wilson, Trask and Tillamook rivers (July 1 to September 15). A variance to the in-water work windows would be requested to extend the allowable construction period through October 31 in 2016 and September 30 in 2017. BMPs and mitigation measures to avoid and reduce potential impacts on coho and other fisheries' resources from construction activities are described in Section 6.

Short-term impacts to the southern DPS of North American green sturgeon would be minor and limited to localized construction disturbances and potential water quality impacts similar to those described for coho.

Under the MSA, EFH in the study area includes the habitats used by Pacific salmon (e.g., coho or chinook salmon), Pacific Coast groundfish, and Coastal Pelagics. Potential impacts to EFH would be moderate and primarily associated with construction activities and would be similar to those described for the Oregon Coast coho. Implementation of BMPs and mitigation measures required to avoid and minimize impacts to coho would also be protective of other fisheries' resources.

Although harbor seals may occasionally use nearby tributary habitats for foraging, the probability of take due to levee removal work in the summer would be very low (Wright et al. 2007; Wright 2015). To limit the likelihood of take even further, the BMPs in Section 6 would be followed to result in no adverse effect on harbor seals. The use of heavy equipment on levees or other over-water structures would stop when marine mammals are within 100 yards of the work area. This would require construction crews to be able to identify harbor seals and to be alert to the potential presence of seals when work is being conducted on the perimeter levees and floodgate structures. Sea lions are not known to occur near the project area; therefore, there would be no effect on Steller sea lions.

Transition Period

Filling of ditches and the initial re-opening of the project area to high tides could create conditions that may result in stranding of Oregon Coast coho. Specifically, high tide inundation, flood events, or other unforeseen weather events may allow juvenile salmon into these newly restored areas where they may become detrimentally stranded within depressions or vegetation as water recedes. Fish stranding potential would decrease as natural channels re-form, vegetation converts to aquatic and tidal wetland species, and depressions fill or are connected to other low-lying areas. In addition, the design of the project, which would include a mandatory review and approval of the design by an NMFS fish passage engineer, and application of appropriate BMPs with respect to fish passage, as described in Section 6, would reduce this potential effect to a minor, local, and non-significant effect.

During the transition period, moderate improvements in Tillamook Bay health and ecosystem function would result in a larger prey base and improved water quality conditions for the southern DPS of North American green sturgeon. This would be a moderate, regional, beneficial effect.

Long Term

In the long term, the Proposed Action would result in a net increase in aquatic habitats and increased productivity of Oregon Coast coho salmon. Increased foraging and refuge habitat for juvenile coho salmon would lead to additional production of juvenile coho salmon and subsequent numbers of adult salmon returning to the Tillamook Bay system (Nickelson 2011). The acreage of viable aquatic habitat for juvenile or adult coho would vary during the transition phase and stabilize over the long term after initial restoration. Implementation of the Proposed Action would create and support four of the six PCEs established in the designation of critical habitat for the Oregon Coast coho salmon ESU (NMFS 2008). These PCE categories include freshwater rearing sites, freshwater migration corridors, estuarine areas, and nearshore marine areas (NMFS 2008). The Proposed Action would support these PCEs by expanding and improving habitat connectivity, availability, and quality. It would increase forage potential in fresh and marine environments for juveniles and improve cover and access for adults. This habitat improvement would represent a major, regional, beneficial effect on Oregon Coast coho salmon.

The Proposed Action would result in a net increase in suitable cover and forage (prey) base for the southern DPS of North American green sturgeon. In the long term, moderate improvements in Tillamook Bay health and ecosystem function would result in a larger prey base and improved water quality conditions for this species.

The Proposed Action is not likely to change the frequency or abundance of marine mammals as the mainstem channels and sloughs that might be habitable by marine mammals would remain unchanged relative to the No Action Alternative. Overall, prey availability and forage quality may increase for these species over time as bay productivity improves and ecosystem health increases, which would represent a major, regional, beneficial effect.

Potential Effects on Marbled Murrelet

Construction

Project construction activities, including the operation of of heavy equipment, disturbances related to earth moving activities, and tree removal, may have the potential to disrupt or disturb nesting Marbled murrelets and nest success. In addition, project construction activities may temporarily disturb foraging behavior of murrelets in adjoining estuary waters. Seasonal and daily timing restrictions on the use of heavy equipment and general disturbance in proximity to potential murrelet usage areas and other conservation measures would be implemented following the project's Marbled murrelet biological assessment and mitigation provisions (USFWS 2015c). Construction effects on foraging behavior by murrelets would be limited in duration, and ample foraging habitat occurs elsewhere in the project vicinity. Any murrelets foraging in waters adjacent to the project site would quickly move out of the project area and into foraging locations further from the construction activity. This would be a minor, local, adverse effect.

The Proposed Action would cause the loss of trees, including some potentially suitable for nesting by Marbled murrelet (USFWS 2015c; NHC 2011). Forty-three potentially suitable nesting trees occur on levee segments planned for removal. Thirty-four of these trees would be retained in tree protection buffers, and nine would be removed. While the current use of trees and forested areas within the study area by Marbled murrelet has not been documented by audio-visual surveys, the area is assumed occupied (USFWS 2015c). Potential nesting trees would be removed outside of the critical nesting season, which is April 1 to September 15. If tree removal is not completed outside of the nesting season, remaining trees would be surveyed for the presence of nesting murrelets. If an active nest is identified, a suitable buffer would be established around the nest tree to minimize impacts of construction activities on nesting birds. Buffers would be established in consultation with USFWS.

The temporal loss of habitat from the removal of suitable (nest trees) or recruitment (trees greater than 60 years old without suitable nesting structure) habitat would be an indirect effect of long duration (up to 5 decades or more). The potential for use and the suitability of the trees for nesting means that their removal would result in moderate adverse impacts to localized habitat use by the species. Because the project will have long-term beneficial effects on the species as described below, there is no mitigation proposed for the loss of potentially suitable nest trees within the project area.

It may not be possible to follow the standard daily timing restrictions on the use of heavy equipment in proximity to potential murrelet usage areas. USFWS is considering the potential benefit of allowing construction to be completed over one nesting season with increased potential disturbance for that one year as compared to requiring construction to be conducted over several nesting seasons. A biological opinion would be issued that would include additional mitigation and minimization provisions that would need to be incorporated into the project design and implementation. Construction activity and disturbances would have a moderate, localized, adverse impact on the potential for Marbled murrelet to nest within the project area during the construction phase.

Transition Period and Long Term

Based on the analysis by USFWS (2015c), the Proposed Action likely would adversely affect Marbled murrelet. Moderate impacts to this species in the short term would include loss of potential nesting habitat and disruption of local foraging opportunities. However, all of the major forested areas along the Wilson River and around Hoquarten Slough are potential nesting areas (USFWS 2015c). While tree replacement is not proposed as a mitigation measure, trees along the Wilson River and Hoquarten Slough outside of the project area would be expected to mature over time, and some would develop suitable nest structure characteristics. Impacts to the species in the transitional period would be moderate, with continued absence of suitable nesting sites, but some benefit from increased ecological function locally and expanded foraging opportunities within the project area. The long-term effects would be moderate, regional, and beneficial because the project would also result in a net improvement to Marbled murrelet habitat, foraging opportunities, and increased nesting habitat over time (USFWS 2015c). USFWS is the lead agency for compliance under Section 7 of the ESA with respect to potential impacts on Marbled murrelet. The project biological assessment includes the conservation measures described above, which would be implemented to avoid and minimize impacts on murrelets and their habitat.

Potential Effects on Other Special Status Species

Construction

Construction of the Proposed Action could result in minor, temporary impacts on California brown pelican through disruption of foraging activities. For example, the noise and activity associated with construction could cause pelicans to feed farther away from the study area during the construction period.

Impacts to plant species protected under the Oregon Endangered Species Act are not expected because it is unlikely that any such plant species occur within the project area, based on the lack of suitable habitat and the absence of identified populations. In addition, USFWS has determined the project would have no effect on listed plant species (USFWS 2015c)

Transition Period and Long Term

Potential disruption of California brown pelican behavior or habitat during the transitional phase of the project would not be anticipated. Over the long term, foraging opportunities for California brown pelican likely would increase as restored salt marsh habitats would result in increased productivity of Tillamook Bay.

Summary of Effects

All project activities that have the potential to impact aquatic habitats would adhere to design criteria and minimization standards to limit potential impacts on listed coho, critical habitat, green sturgeon, and EFH as outlined in PROJECTS (NMFS 2013a) and as described in Section 6. These guidelines would apply to the use and operation of heavy equipment, erosion control, general project design, invasive species control, fish passage, fish capture and removal (salvage), and work area isolation.

Construction of the Proposed Action could result in moderate, local, short-term, adverse impacts on special status species and critical habitat. Implementation of mitigation measures and BMPs described in Section 6 would be required to avoid or reduce construction-related impacts to listed species and essential fish habitat. With implementation of the BMPs and mitigation measures, construction-related and transitional impacts would be less than significant. Over the long term, the Proposed Action would result in major, local and regional, beneficial effects on listed species and designated critical habitat.

4.6.3.3.3 Alternative 2: Hall Slough Alternative

Construction

As described in Section 4.6.2.3.3, in-water construction work in Hall Slough under Alternative 2 would result in a moderate, short-term impact on fish species, including the listed Oregon Coast coho and green sturgeon. As with the Proposed Action, in-water work for the Hall Slough Alternative would only occur during the ODFW in-water work period. While PROJECTS would not provide ESA coverage to the channel widening and dredging proposed under the Hall Slough Alternative, many of the BMPs and design criteria for levee setback and tide gate design, installation, and operation would be applied to this alternative to minimize potential impacts. Additional BMPs applicable to proposed dredging are described in Section 6.

There would be no effect on harbor seals from in-water work because they would be unlikely to occur in the slough channel during construction.

There would be no effect on listed plant species under the Hall Slough Alternative because the areas along the slough that would be impacted by construction have been highly modified by past dredging, levee construction, and agricultural activities.

Transition Period and Long Term

Periodic maintenance dredging that would be required under the Hall Slough Alternative would result in periodic short-term, minor, adverse impacts on listed fish species, including the Coastal coho salmon. Maintenance dredging likely would be needed every 2 to 5 years and would be conducted during the approved in-water work period and in conformance with BMPs for fish exclusion and dredging. In the long term, the Hall Slough Alternative would benefit Oregon Coast coho and green sturgeon by reestablishing a connection to the Wilson River at the upper end of Hall Slough and creating better aquatic connectivity along its length. The alternative also would restore approximately 90 acres of riverine flow-through wetlands along the banks of Hall Slough that would improve habitat and water quality conditions within the Slough. It is anticipated there would be increased fish use of Hall Slough for migration, rearing, and foraging as a result of the improved connectivity. This improved habitat condition would result in moderate, regional benefits to designated critical habitat and EFH.

Maintenance dredging under the Hall Slough Alternative would have no effect on marine mammals because they are unlikely to use the slough. The moderate improvements in fish habitat and corresponding fish populations would result in increases in the prey base for marine mammals, which would be a minor beneficial effect.

The Hall Slough Alternative would have no effect on Marbled murrelet as it would not affect the potential murrelet nesting trees in the SFC area. There would be only minor improvements to the populations of fish prey species used by California brown pelican.

The gradual conversion of agricultural lands on the County-owned lands in the SFC area to freshwater wetlands would have no effect on listed species because freshwater wetlands are not a limiting factor for listed species that may occur in Tillamook County, and they would not be very accessible to fish.

Summary of Effects

Alternative 2 could result in potential moderate, local, adverse impacts on listed species and critical habitat during construction and periodic maintenance dredging activities that would be significant. Effects on listed fish species and their habitats from dredging activities could include behavioral changes associated with short-term and localized increases in turbidity and short-term reductions in benthic invertebrate production. However, these short-term and localized effects are not likely to result in significant adverse effects on feeding behavior, use of preferred habitat, or migration behavior of any special status aquatic species. Implementation of mitigation measures and BMPs described in Section 6 would be required to avoid or reduce impacts on coho salmon and critical habitat such that the alternative would be not likely to adversely affect listed species during construction. With implementation of the BMPs and mitigation measures, the Hall Slough Alternative would result in moderate, long-term beneficial effects on special status species.

4.6.3.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction

Construction of Alternative 3 would involve the same activities and result in similar impacts as those described for the Proposed Action. Work would occur on the same schedule as proposed under Alternative 1. Although the project involves more levee work, the schedule would remain the same because it is constrained by the in-water work timing restrictions.

Construction-related impacts would include short-term, moderate, local, adverse effects from in-water work, fish handling procedures, and potential short-term, localized impacts on water quality. There would be an initial period of time when there would be the potential for Oregon Coast coho or other special status fish species to become stranded in the areas newly opened to tides. Detrimental effects on the listed Oregon Coast coho ESU would be limited due to adherence to mitigation measures and BMPs as outlined by the PROJECTS programmatic restoration opinion (NMFS 2013a) and as described in Section 6. The adverse effects from project construction ultimately would be outweighed by major increases in available rearing habitat, migration corridors, refuge areas, and foraging potential.

As described under the Proposed Action, there would be no adverse effect on harbor seals because they would be very unlikely to occur near the project area during summertime levee removal work, and the BMPs in Section 6 would be implemented to ensure that should any seals approach the work area, they would not be disturbed.

The potential impacts and benefits of Alternative 3 on Marbled murrelets would be the same as those described under the Proposed Action with respect to the removal of nine potentially suitable nesting trees through removal of levees. The loss of potentially suitable nest trees would be a moderate, local, long-term adverse effect on murrelets. BMPs and mitigation measures for avoidance and minimization of impacts would be followed (USFWS 2003b) as described in Section 6.

Potential minor, short-term, construction-related impacts on California brown pelican would be the same as described under the Proposed Action. Similar to the Proposed Action, there would be no effect on special status plant species as there are none expected in the project area.

Transition Period and Long Term

Much like the Proposed Action, implementation of Alternative 3 would create and support four of the six PCEs for designated critical habitat for the Oregon Coast coho salmon ESU (NMFS 2008). These PCE categories include freshwater rearing sites, freshwater migration corridors, estuarine areas, and nearshore marine areas (NMFS 2008). Alternative 3 would support these PCEs with expansion and improvement of habitat connectivity, availability, and quality. It would increase forage potential in fresh and marine environments for juvenile fish and improve cover and access for adults. This would be a major, regional, beneficial effect on Oregon Coast coho salmon

There would be an initial period of time when there would be the potential for Oregon Coast coho or other special status fish species to become stranded in the areas newly opened to tides. However, the design of the project and application of appropriate BMPs as described in Section

6 with respect to fish passage would reduce this potential effect to a minor, local, and non-significant effect.

Alternative 3 would also increase suitable green sturgeon habitat during project transition and long-term timelines. It would benefit green sturgeon with an improved prey base, an increase in aquatic habitat and cover, and improved water quality conditions.

Alternative 3 would result in more habitat than the Proposed Action because the levees around an additional 86 acres would be removed, allowing those areas to convert to wetlands and form side channels. Under Alternative 3, approximately 568 acres of tidal and brackish wetlands would be restored as compared to 522 acres under the Proposed Action. It is also expected there would be more than the predicted 14 miles of side channel habitat reformed under Alternative 3 because of the additional area re-opened to tidal fluctuations. This increase in available tidal habitat would be a major, regional, long-term benefit for listed coho, EFH, and other species that use estuarine habitats.

The potential impacts and benefits of Alternative 3 on Marbled murrelets through the temporal loss of habitat from the removal of suitable or recruitment habitat trees would be a moderate, local, long-term, adverse effect (up to several decades). However, the long-term net increase in foraging and nesting habitat would result in moderate, regional, beneficial effects.

Summary of Effects

Construction of Alternative 3 could result in potential moderate, local, short-term, adverse effects to special status species and designated critical habitat that would be significant. As described for the Proposed Action, the use of BMPs and mitigation measures would be required during implementation of Alternative 3 to avoid or reduce impacts to threatened and endangered species, including Oregon Coast coho salmon, its designated critical habitat, Marbled murrelet, and EFH to a less than significant level. These mitigation measures are described in Section 6. Alternative 3 would create major, local and regional, long-term, beneficial effects on special status species and designated critical habitat through improved ecosystem connectivity.

4.7 Physical Resources

This section describes the physical resources of the project area and provides an evaluation of the potential environmental effects of each of the alternatives related to geology and soils, coastal resources, air quality, climate change, and visual quality and aesthetics.

4.7.1 Geology and Soils

This section describes the current conditions of geology and soils and analyzes potential impacts related to seismic issues, fluvial geomorphology, and conversion of farmland soils as a result of implementing the proposed alternatives. Effects on the agricultural industry are evaluated in more detail in the regional economic effects section.

4.7.1.1 Seismicity

An earthquake can result in several different types of hazards, including strong ground shaking, surface fault rupture, soil liquefaction and lateral spreading, and induced landslides and tsunamis or seiche (a standing wave in an enclosed or partially enclosed body of water such as Tillamook Bay). This section presents an overview of the regional seismicity and seismic hazards present in the study area and then evaluates the risks and hazards associated with each of the project alternatives.

4.7.1.1.1 Methodology

The methodology for evaluation of impacts related to seismic issues included consideration of the seismic hazards present in the study area and the extent to which the project alternatives could be affected by or exacerbate those hazards.

4.7.1.1.2 Affected Environment

Regional Seismicity

The Pacific Northwest is a seismically active area with a tectonic environment different from other parts of the contiguous United States. The main tectonic feature in the Northwest is the Cascadia Subduction Zone (CSZ), which is primarily responsible for the regional seismicity and volcanic activity (Crouse 1994). The CSZ is located offshore of the Pacific Coast where the Juan de Fuca tectonic plate is plunging beneath the North American tectonic plate. The CSZ stretches approximately 750 miles from Vancouver Island in British Columbia to Cape Mendocino in California and is located approximately 78 miles west of the study area.

Earthquakes in the western part of Oregon occur as a result of the collision of these two plates and related volcanic activity. Earthquakes associated with the CSZ may originate from several seismic source mechanisms, including:

- Interface source mechanisms: Interface earthquakes occur at the interface boundary of the CSZ at depths of less than approximately 19 miles and historically are the largest types of earthquakes observed worldwide. Prehistoric geologic evidence gathered from coastal areas in Washington and Oregon indicates very large, megathrust earthquakes of estimated moment magnitude (M_w) 8 to 9 originate at irregular intervals from the subduction interface source. There is consensus within the scientific community that the last megathrust earthquake occurred along the CSZ on the evening of January 26, 1700. The date of the event is known from written records of a tsunami in Japan attributed to the earthquake (Satake et al. 1996), the timing of which is consistent with other data such as turbidity currents, vegetative changes, and changes in growth rings in trees along the Pacific Coast (Adams 1990; Atwater et al. 1995; USGS 2005). It is estimated the 1700 CSZ event had an M_w between 8.7 and 9.2, and ground shaking may have continued for up to 3 or 4 minutes. Estimates give the probability of a full-length rupture of the CSZ occurring during the next 50 years as 7 to 11 percent. The probability of a rupture on the southern portion of the CSZ in the next 50 years is 18 to 43 percent, depending on the model used (USGS 2012).

- Intraplate source mechanism: Intraplate earthquakes occur within the subducting Juan de Fuca plate, have a deeper focus than interface earthquakes, and typically occur along normal faults as a result of stress and physical changes in the subducting slab. Events associated with this source are estimated to range from M_w 6 to 7.5, based on historical occurrences (Geomatrix Consultants 1995). Three earthquakes in recent history have been attributed to the intraplate source: the 1949, 1965, and 2001 earthquakes in the Puget Sound region, with M_w of 7.1, 6.5, and 6.8, respectively.

- Shallow crustal sources: Crustal events result from built-up tectonic stresses within the North American Plate and are shallow earthquakes. Crustal earthquakes are further categorized as occurring on discrete fault sources where repeated earthquakes have occurred in the geologic past, or within areal source zones where earthquakes have been observed and may occur again, but have not been associated with any specific geologic features.

Depending on the magnitude of the event and the location of the site in relationship to the fault rupture, strong ground shaking could occur for several minutes and potentially up to 4 minutes. This long duration can result in damage to certain types of structures and facilities that might not be damaged at the same strength of shaking produced by a smaller earthquake.

Seismic Hazards

The primary seismic hazards associated with the project location include soil liquefaction that could result in both settlement and lateral spread and tsunami and seiche inundation.

Liquefaction can result in a loss of bearing capacity, soil consolidation and settlement, buoyancy of objects buried in the soil, and lateral spreading. The susceptibility of a soil deposit to liquefaction is a function of the degree of saturation, soil grain size, relative density, percent fines, age of deposit, plasticity of fines, earthquake ground motion characteristics, and several other factors.

Lateral spreading (also called lateral displacement) is movement of the ground laterally on a zone of liquefied soil. While identification of liquefaction hazards is generally accepted as reliable, estimates of the potential for seismic induced settling and lateral spread are much less reliable.

A geotechnical investigation was conducted to evaluate slope stability, settlement, seepage, and seismic issues related to the proposed levee construction for the Proposed Action (Shannon and Wilson, Inc. 2014). Organic soils and saturated soils are at a greater risk of liquefaction in the event of an earthquake. This geotechnical investigation indicates there are areas of deep peat soils within the study area and large areas where soils are saturated most of the time (Shannon and Wilson, Inc. 2014). These results indicate that soils under the levee embankments are highly susceptible to liquefaction, flow failure, and lateral spreading during a seismic event.

The Oregon Department of Geology and Mineral Industries (DOGAMI) manages the National Tsunami Hazard Mitigation Program to help cities, counties, and other sites in coastal areas reduce the potential for disastrous tsunami-related consequences by understanding and mitigating this geologic hazard. The DOGAMI mapping was developed for five seismic events referred to as “Small, Medium, Large, Extra Large, and Extra Extra Large,” and the magnitudes range between approximately 8.7 and 9.1. According to the most recent tsunami hazard mapping available from DOGAMI (DOGAMI 2012), the study area has a high potential to be inundated during a significant tsunami event although only the western three quarters of the SFC project area is predicted to be inundated by a “Small” tsunami producing event.

The Tillamook County Department of Emergency Management maintains a website with educational information regarding earthquake and tsunami hazards, emergency operations plans, and communication systems, including sirens and other warnings to help residents and visitors along the entire Oregon coast prepare for the next CSZ earthquake and tsunami.

Seismic hazards may also result directly from fault rupture that damages surface structures and facilities. However, since there are no known active faults crossing the site, the risk of surface fault rupture impacting the project is considered to be low for each of the alternatives.

4.7.1.1.3 Environmental Consequences

Impacts would be significant if implementation of the project alternative resulted in an increase in risk to public safety or property during a seismic event, including an earthquake and/or tsunami.

No Action Alternative

Construction, Transition Period, and Long Term

There would be no effects related to seismic concerns under the No Action Alternative because the existing conditions would not change. Existing levees would continue to be subject to earthquake, tsunami, liquefaction, and other seismic hazards present in the study area.

Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Construction, Transition Period, and Long Term

Based on the results of the geotechnical investigation, the proposed levees and foundation materials are expected to have adequate shear strength to resist slope failure under static (non-seismic loading). New levees would be engineered to minimize the potential for seismic impacts prior to construction; however, the earthen levees would still be vulnerable to the potential effects of a major CSZ event.

New levees would experience settlement of varying amounts, depending on the composition of underlying native material, particularly tidal flat deposits. New setback levees would be built somewhat higher than needed to allow for settling. After the majority of the settlement is completed, levees would be regraded to achieve the final design elevations, thereby reducing impacts related to settlement. Due to potential seepage, the engineering design incorporates recommended new locations for the north, middle, and south levees as identified by the geotechnical analysis (Shannon & Wilson, Inc. 2014). In addition, piezometers would be installed to monitor pore water pressures in certain areas, and a toe drain would be installed on the landside of the middle levee floodgate.

Based on preliminary screening results, the soils under the levee embankments are highly susceptible to liquefaction, flow failure, and lateral spreading during a seismic event (Shannon & Wilson, Inc. 2014). Although it is likely the levees would otherwise perform with relatively minor amounts of deformation during a seismic event, the underlying soils could experience significant seismically induced settlement and lateral spread that could compromise the integrity of the levee system. The settlement of the soils underlying the levees would slightly reduce the potential for liquefaction, but the improvement would be minor. Therefore, seismic hazards would pose major, local, adverse effects on levee stability. The soils in the project area and the presence of severe seismic hazards could result in levee failure in the event of an earthquake. If levees fail during unusually high tides or during a flood, there could be significant flooding of lands in and adjacent to the project area. However, flooding likely would not be worse than under the No Action Alternative under similar circumstances.

The Proposed Action would not exacerbate the existing tsunami hazards in the study area. The new levee configurations would be unlikely to alter the risk of tsunami hazards within the Tillamook Valley.

Therefore, although seismicity and seismic hazards pose major regional risks in the study area, the Proposed Action would not significantly alter the existing conditions with respect to those risks and hazards.

Alternative 2: Hall Slough Alternative

Construction, Transition Period, and Long Term

Potential impacts related to levee slope stability, settlement, seepage, and seismic issues would be expected to be similar to those described for the Proposed Action. Although detailed geotechnical investigations have not been conducted for the Hall Slough Alternative, it may be assumed there would be some areas where settlement and seismic stability would be a concern. The Hall Slough Alternative is located at somewhat higher elevations than most of the Southern Flow Corridor study area, and large sections are not located in wetland areas, which should reduce potential concerns related to soil stability underlying the proposed new setback levees. However, this alternative would construct more than twice the length of new and setback levees. It is assumed additional geotechnical evaluation would be needed if this alternative is selected. It is likely the concerns related to liquefaction and lateral spread of soils underlying much of this new setback levee would be similar to those identified for the Proposed Action.

Alternative 2 would not exacerbate the existing tsunami hazard in the study area. Most of the Alternative 2 project area, almost to the upstream end of Hall Slough, is within the existing hazard zone for tsunami risk.

Therefore, although seismicity and seismic hazards pose major regional risks in the study area, the Hall Slough Alternative would not significantly alter the existing conditions with respect to those risks and hazards.

Alternative 3: Southern Flow Corridor – Initial Alternative

Construction, Transition Period, and Long Term

Potential impacts related to levee slope stability, settlement, seepage, and seismic issues would be the same as those described for the Proposed Action. However, because the proposed levees would be in somewhat different locations, additional detailed geotechnical investigations would need to be conducted. It is likely the concerns for liquefaction and lateral spread of soils underlying much of this new setback levee would be similar to those identified for the Proposed Action.

Alternative 3 would not exacerbate the existing tsunami hazard in the study area. The new levee configurations would be unlikely to alter the risk of tsunami hazards within the Tillamook Valley.

Therefore, although seismicity and seismic hazards pose major regional risks in the study area, Alternative 3 would not significantly alter the existing conditions with respect to those risks and hazards.

4.7.1.2 Fluvial Geomorphology

This section presents an evaluation of sediment transport and geomorphology in the study area. The sediment transport and geomorphic regimes influence flooding and habitat through their interactive impacts on the channel and floodplain topography (Appendix E and Appendix J). Action alternatives that could alter channel or floodplain topography (e.g. through the removal of levees) would be expected to also have effects on flooding and habitats.

Several federal and local regulations and policies, including the CWA, the Clean Air Act (CAA), and the County and City comprehensive plans, direct that soils should be protected from erosion to prevent water and air quality degradation and to protect the productivity of the land. These regulations and policies are described in more detail in Appendix C.

4.7.1.2.1 Methodology

In the Geomorphology and Sediment Transport Evaluation Report (Appendix J), the scientific literature about the geomorphic setting, sediment transport processes, and causes of sedimentation in Tillamook Bay were reviewed and discussed. Also, the existing sediment transport conditions were briefly evaluated using output from the 1-Dimensional (1-D) hydraulic model (HEC-RAS) available for the site. Following the evaluation of the existing conditions, the anticipated geomorphic consequences of the No Action Alternative, and the three action alternatives were evaluated. The anticipated consequences of each alternative were described for the short term, transition period, and long term.

In addition, NHC evaluated sediment transport regimes for the Proposed Action in the rivers and sloughs draining into the south end of Tillamook Bay (NHC 2015). The evaluation considered both flood and low-flow, tidally dominated conditions. The analysis applied two different methods to evaluate potential project-related impacts on in-channel sediment transport characteristics during floods: the Excess Shear Stress Approach and the Engelund-Hansen Sediment Transport Capacity calculation. In both cases, the relative change in calculated values is the parameter of interest. There is greater certainty about the computed relative change than there is about the values of sediment transport under the pre- and post-project conditions. Sediment transport was evaluated for particles 1 millimeter (mm) in size. While larger than the typical 0.125 to 0.25 mm sands found in Tillamook Bay, this size particle accounts for the upstream coarsening of sediment that is common in rivers and is somewhat conservative, as larger particles have higher critical shear stresses. Sediment transport capacity calculation was performed using HEC-RAS for the 1.5-year, 5-year, 22-year, and 100-year floods. The modeling effort and the results are described in more detail in Appendix J.

4.7.1.2.2 Affected Environment

Geologic Setting

The Tillamook alluvial plain is underlain by fine-grained marine sedimentary rocks and associated volcanic rocks. The Siletz River Volcanics (Tsr) are the oldest rock unit identified in the basin at about 50 to 62 Ma (mega-annum or millions of years) old, making them early Eocene. The typical suite of volcanics consists of aphanitic to porphyritic flows, tuff breccias, and some massive lava flows. Tectonic activity created sills of thoeleiitic alkolic basalt. The upper units are interbeds of basaltic siltstone, sandstone, tuff, and conglomerate. The origin for most of the unit is marine with seafloor deposits interbedded (Walker and MacLeod 1991, as cited in Pearson 2002).

Soil Types

The project area is located primarily in the coastal plain of Tillamook County, which includes beaches, dunes, marine and river floodplains and terraces, estuaries, and tidal flats. The Coastal Lowlands ecoregion in which the project area is located consists of deep, fertile, silty and clayey soils. At elevations from sea level to about 1,800 feet, the coastal lowlands have cool, wet winters and cool, moist summers. The abundant moisture and modified air and soil temperatures in the fog belt result in a cool, long growing season that promotes a large accumulation of organic matter in the soil profile. The high rainfall promotes extensive leaching of bases, resulting in low base saturation of the soils. The native plant community is predominantly conifers, which also absorb bases and do not readily return them to the soil.

The distribution of soil types for Alternatives 1 and 3 is shown on **Figure 4.7-1** and for Alternative 2 on **Figure 4.7-2**. The majority of the study area is made up of three soil types, described as follows:

- Fluvaquents-Histosols complex, 0 to 1 percent slopes, diked: These soils occur in coastal freshwater swamps and tidal marshes at an elevation of 0 to 10 feet above sea level. The parent material is estuarine deposits. They are very poorly drained and frequently flooded, with a seasonal high water table that occurs at the soil surface to a depth of 4 inches (NRCS 2014).
- Coquille silt loam, 0 to 1 percent slopes, diked: These soils occur in estuaries and tidal marshes at an elevation of 10 to 20 feet above sea level. The parent material is estuarine deposits. They are very poorly drained and frequently flooded, with a seasonal high water table that occurs at the soil surface to a depth of 6 inches (NRCS 2014).
- Nehalem silt loam, 0 to 3 percent slopes, frequently flooded: These soils occur in floodplains at an elevation of 10 to 200 feet above sea level. The parent material is alluvium. They are well drained but frequently flooded, with a relatively deep water table (NRCS 2014).

During a geotechnical investigation of the proposed construction areas for Alternative 1 within the SFC study area, four geotechnical soil units were encountered, including fill, tidal flat deposits, peat, and alluvium (Shannon & Wilson, Inc. 2014). Fill was encountered in most of the investigation locations and consists of sand and gravel, silt, wood/lumber debris, and occasionally anthropogenic debris such as wire, plastic, and glass. Fill was found at the ground surface to depths ranging from 4 to 9 feet and overlying native material. Because the geotechnical investigation focused on areas where levees had been previously constructed and dredge spoils deposited, the high frequency of fill materials in the test pits is not unexpected.

Tidal flat deposits were encountered in all test pits, ranging between depths of 13 and 32 feet, typically underneath fill material but at the surface at a small number of locations. Tidal flat deposits generally consist of very soft to soft, occasionally medium-stiff, gray or brown elastic silt with some to trace fine to medium sand. Peat was encountered at the surface in four locations and extended to depths ranging from 4 to 13 feet. Peat deposits generally consist of very soft, brown fibrous organics with little to some low- to medium-plasticity fines. Alluvium was encountered below the tidal flat deposits in all drilled borings except in two. The alluvium unit typically consisted of loose to medium-dense, gray, silty sand or a mixture of sand and silt with some gravel.

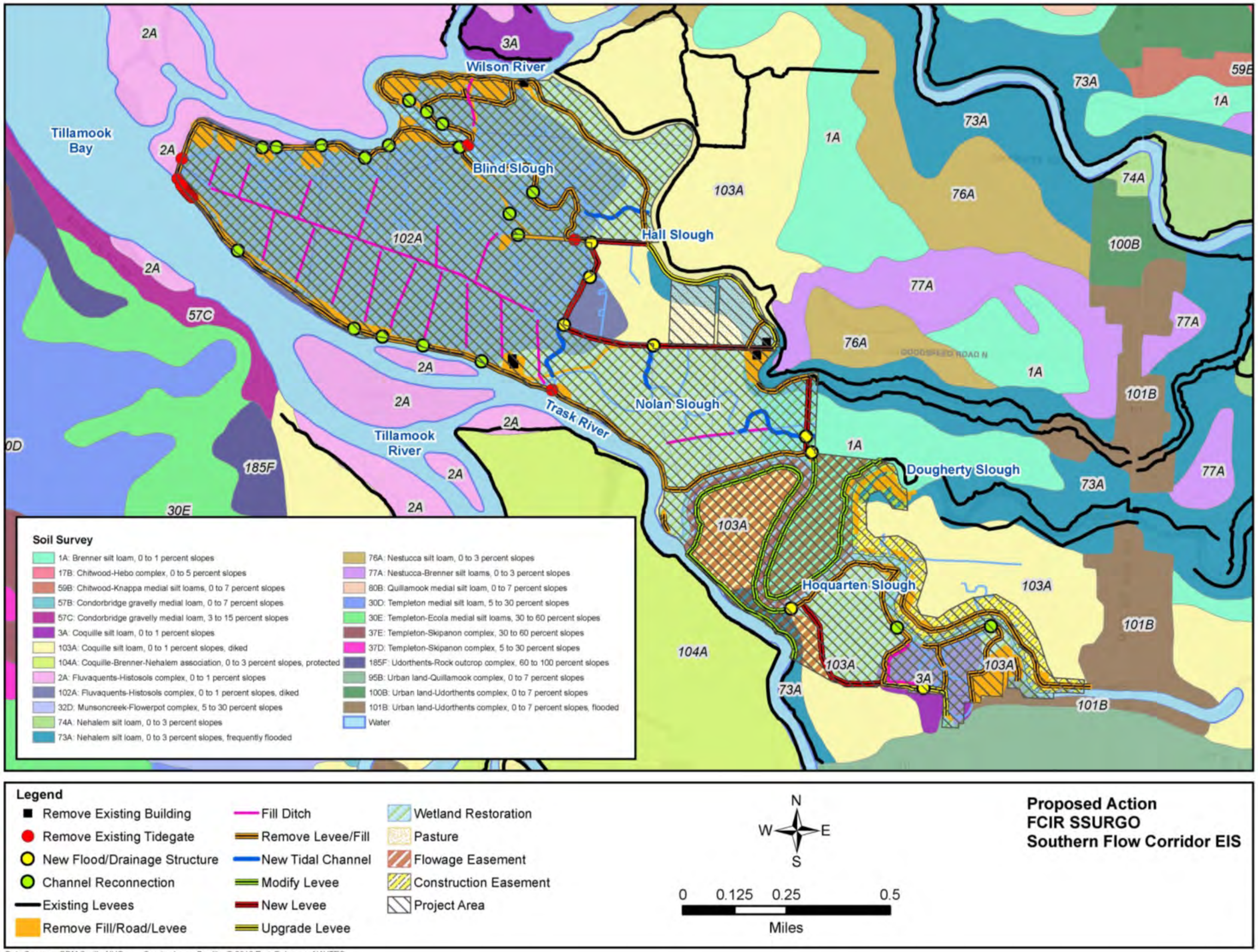


Figure 4.7-1. Soil Types within the SFC Study Area (Alternative 1 and Alternative 3)

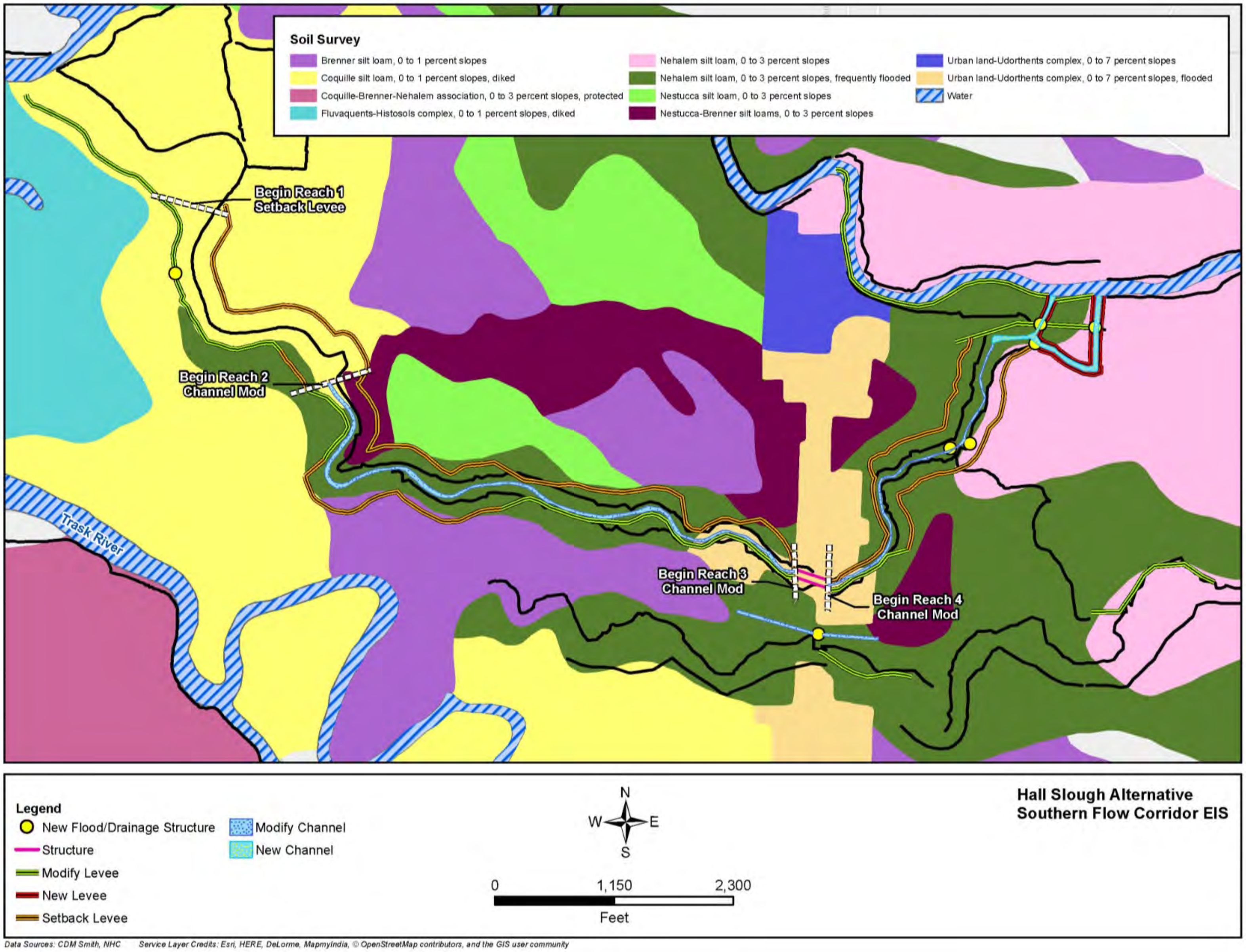


Figure 4.7-2. Soil Types with the Hall Slough Study Area (Alternative 2)

Erosion Potential

Soils in the mountainous sections of the Tillamook Bay watershed are volcanics of Tertiary age, which are highly weathered and subject to mass movements and other types of slope failure processes. Historical forest fires exposed large amounts of erodible soils in upland/mountain areas. During storm events, high runoff discharges can transport high volumes of sediment out of the mountain reaches, causing sediment loading of the stream and river channels. Upland slope failure is the major contributor to the current sediment loading process in Tillamook basin (Pearson 2002). However, erosion hazard in the study area in the flat lowlands of the lower valley is considered "slight," indicating erosion is unlikely under current conditions (NRCS 2014). Historical accounts document an overall pattern of aggradation (sediment deposition) in the lower Trask, Tillamook, and Wilson rivers (Appendix E). The tides in Tillamook Bay have a strong influence on flow and sediment transport in the area's rivers and sloughs, especially under low river flows.

4.7.1.2.3 Environmental Consequences

The evaluation of impacts related to fluvial geomorphology included the potential for the project alternatives to affect the natural processes associated with sediment transport within the surface waters in the study area, including the Tillamook, Trask, and Wilson rivers and Tillamook Bay.

Impacts would be significant if implementation of an alternative would result in an increase in soil erosion and sedimentation such that there would be adverse effects on biological resources (e.g., changes in substrate, harm to aquatic wildlife), loss of topsoil, or flooding of improved property.

Construction period effects are described for the time during construction and the first year following construction. Transition effects include the time period for vegetation to transition and become re-established (the first 1 to 3 years following construction) and the time period for relict and new side channels to reform (up to 20 years following construction). Long-term effects include those effects that would occur following the transition period (generally more than 20 years following construction).

No Action Alternative

Construction

Under the No Action Alternative, there would be no construction or construction-related impacts on fluvial geomorphology.

Transition/ Long Term

Under the No Action Alternative, there would be no changes to the erosion potential of lands in the study area because the existing conditions would not change. The study area has been isolated from annual floods for the past 50 years or so by perimeter levees built up with dredge spoils from the adjacent rivers and sloughs. The organic material within the study area is decomposing, and that decomposition combined with a cessation of annual sediment load inputs from the rivers has led to a subsidence of the ground elevation within the study area. In some locations, the subsidence may be as much as 3 feet, which is the observed difference between the northwest portion of the study area and undiked marsh lands across the Wilson River. This equates to a rate of approximately ½ inch per year. Under the No Action Alternative, this subsidence would be expected to continue for the foreseeable future. If decomposition is responsible for a portion of the subsidence, the rate of decomposition of organic matter would be expected to decrease over time, but it would not be expected to stop or reach a negligible rate for a very long time.

While the area within the SFC project area may be subsiding, the floodplain in general and the adjacent river channels are aggrading. The current trend of channel aggradation at a rate on the order of 20 to 40 centimeters (cm) per century would continue and probably would increase with sea level rise. Therefore, over time, under the No Action Alternative, the interior of the SFC project area might be expected to continue to be disconnected from the surrounding floodplain and to subside relative to adjacent areas. With the cessation of agricultural practices and eventual phasing out of levee maintenance, the combination of levee deterioration, sea level rise, and adjacent channel aggradation, it would be expected the SFC area would experience more flood events that would begin to bring some additional sediment inputs into the area, thus, reversing some of the potential subsidence.

In addition, the existing channel locations and forms would not be expected to change. The perimeter of the study area along the major rivers and Hall Slough is armored, and the upstream segments of Hall Slough are constrained by the existing levees. The existing system of levees prevents channel migration and has cut off the former tidal channels in the interior of the study area from tidal influences that could otherwise be expected to maintain them.

Sea level rise would be the primary factor causing long term geomorphic impacts. Sea level rise of 1 to 2 feet is forecast for the Oregon Coast over the next century. Sea level rise of more than two feet would affect the hydraulics of the project area, causing more overbank flooding, and subsequent floodplain sedimentation, over time. The project area is generally located within an aggrading area and sea level rise would promote that trend. See Section 4.7.4.4.1 for a discussion of the effect of climate change including sea level rise.

Over the long term, the No Action Alternative would result in moderate, regional, adverse long-term impacts on fluvial geomorphology from continued disruption of natural fluvial processes, which would be less than significant.

Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative (Proposed Action)

Construction and Transition Period

The Proposed Action would entail a large amount of earth-moving to construct. During construction, erosion of disturbed soils could occur in upland areas, within the floodplain, and within channels. In upland areas, construction vehicles and haul trucks could track soil onto roadways where it could be washed into the storm drainage system or surface waters. Erosion of soil could also occur from exposed stockpiles, cleared and compacted areas created for staging areas, and access roads.

Similarly, in floodplain areas, soil erosion could occur where soil has been disturbed, including at newly constructed levees, removed or modified levees, and new tidal channel reconnection points. Removal of existing riparian vegetation could increase runoff and erosion of soils to adjacent surface waters.

Within channels, erosion and sedimentation could be a major, local, adverse impact. The Proposed Action would have moderate, localized impacts on the sediment transport regime in the Wilson River near the project area, increasing stream power in some areas while reducing it in other areas. The reduction in in-channel stream power reflects more flow leaving the channel into the floodplain as a result of the project. It is possible, but not certain, that the change in stream power during flood flows could contribute to additional aggradation of the Wilson River in the vicinity of the project, as well as possible fining of bed sediment in that area as a result of the project.

In the Trask River, potential impacts of the Proposed Action on sediment transport rates would be negligible. Newly connected tidal channels would be expected to evolve quickly over first 20 years of the project. Lengthening of the channel network and widening of individual channels would occur relatively rapidly within the first few years (NHC 2014b). The rate of evolution of newly connected tidal channel network is not presently known. The extent of tidal channel network formation would depend on the hydraulics and sediment properties (i.e., the resisting and eroding forces). The new tidal channel inlet/connection points would be expected to evolve the most quickly of the new tidal channel network components. The initial inlet configuration would determine the amount of water entering the tidal channels and drive how the final tidal channel forms.

On the northern side of the project area, where existing channels would be reconnected, the newly connected tidal channels should become functional tidal channels quickly, exchanging water and sediment in a manner similar to other tidal channels in Tillamook Bay. The Proposed Action would include excavation of reconnection points through the river banks to connect the Trask River with the approximate locations of historic channels. It is expected that new tidal channels would form from these locations, although they may not reform in exactly the same places as the historic channels because the original channel shapes have been mostly obliterated by cultivation.

Increased sedimentation on the floodplain surface would result from the Proposed Action. The greatest amount of sedimentation in the floodplain would occur as splays at new levee breach locations. Sands would deposit close to main channels, especially in splays. Very fine sand and silt would deposit farther away from the breaches. Clay generally would settle only where standing water occurs following floods over the newly connected floodplain.

In-water excavation or riprap removal could generate sediment that would increase turbidity locally and in downstream waters. Construction activities where tide gates and floodgates are proposed to be added, removed, or modified may generate sediment that could enter nearby waters. Additionally, flows passing through new floodgates could erode floodplain surfaces where they are concentrated to pass through the structure. New channels would be constructed to connect the floodgates to existing channels to help minimize this potential impact.

There is the potential for soil erosion to be a major, local impact under Alternative 1 during construction and in the transition period (1 to 3 years) until vegetation becomes re-established. BMPs as described in Section 6 would be required to avoid or reduce soil erosion impacts to a moderate and less than significant level.

Long Term

Over the long-term, rates of distal floodplain accretion are unknown, but would probably be less than about 1 cm/year. The actual rate and pattern of floodplain sedimentation would depend on future floods, sediment concentrations, and 2-dimensional floodplain hydraulics not captured by the 1-dimensional HEC-RAS model. Generally, diffuse sedimentation rates in the floodplain would be greatest where flows enter the floodplain and would decrease with distance from the channel. With the restoration of floodplain connectivity and reintroduction of natural hydraulic regimes and sedimentation, the observed subsidence of the project area would be expected to cease. The predicted accretion rate of approximately 1 cm per year is approximately equivalent to the estimated subsidence rate of 1 cm per year.

The only reach that shows a risk of aggradation in the modeling is lower Hall Slough. Removal of levees along the left bank of Hall Slough would allow both flood waters and high tides to spill into Blind Slough rather than flow through the lower end of Hall Slough. This would reduce flows and allow for aggradation in the lower end of Hall Slough.

Modeling of tidal channel geomorphology showed that the majority of the river reaches, including the Wilson River and Dougherty and Hoquarten sloughs, would experience minimal change from existing conditions under tidally driven conditions. Moderate reductions in sediment transport are expected in downstream portions of Hall Slough, which is related in part to the diversion of a portion of the high tides to Blind Slough under the Proposed Action. The greatest change in channel area would occur in Blind Slough. Removal of the levees and the plug across the slough would allow most of the daily tides that inundate the northern restoration area to drain through the slough unimpeded reducing the volume of flow in Hall Slough.

Overall, the modeling predicts that most reaches would have no change or increased sediment transport capacity. This is attributed to two factors. In the upper reaches, the project generally would result in increased instream velocities and hence shear stresses by the removal of impediments to flows. In the lower reaches, shear stresses during floods could be lower, but the channels are mostly tidal dominated, so this reduction would not affect long-term channel form. Under low-flow conditions, the project generally would have minor, localized effects, with the notable exception of Blind Slough, which is expected to undergo a major expansion.

Sea level rise would increase flooding directly by raising the water surface elevation of the project area and indirectly by inducing sedimentation that would result in base elevation rise. Data show that the sediment supply is abundant enough to keep up with rising sea levels, which would indicate that a tidal marsh would continue to persist in the vicinity of the project area. However, it also means that the elevation of the floodplain and the river channels would aggrade to keep up with sea level rise. While this would lead to a reduction in flood conveyance capacity compared with the current condition, it would not necessarily be much different from the No Action Alternative where sea level rise would also cause channel aggradation of the river beds. Channel aggradation would probably increase the frequency, magnitude, and duration of overbank flooding within and upstream of the project area. See Appendix E for more discussion of the hydraulic modeling.

Over the long-term, it is assumed some erosion of new levees would occur, particularly during floods greater than 10-year events. The levees would be designed to pass floods and minimize erosion. Regular maintenance would keep this impact to a minor, local, less than significant level. In addition, erosion of some river bank areas would be expected following the removal of riprap bank protection. This would be considered a beneficial effect, as riprap removal is intended to allow for more natural channel forming processes to occur.

Alternative 2: Hall Slough Alternative

Hall Slough is a side channel of the Wilson River. The slough's origins are upstream of Highway 101 near the Wilson River Loop Road, and its downstream end comes back into the Wilson River near the mouth of the river. Hall Slough was connected to the Wilson River at its upstream end before 1950. At that time, a bridge was in place that crossed Hall Slough on the Wilson River Loop Road. Since then the slough has been filled at its upstream end, the bridge removed, and a small culvert placed through the Wilson River Loop Road to drain the area behind it.

Construction and Transition Period

Although Alternative 2 has a much smaller footprint than Alternative 1, there is potential for major, local impacts from erosion of soils during construction and during the transition period (1 to 3 years), until vegetation becomes established to stabilize the soil. BMPs related to soil erosion and sedimentation, as described in Section 6, would be required to avoid or reduce soil erosion to a moderate and less than significant level.

The volume of sediment delivered to the study area would be the same as under the No Action Alternative; however, the patterns of transport and deposition of sediment within the project area would be different. Under this alternative, a portion of flow would leave the Wilson River main stem and flow through Hall Slough before returning to the Wilson River main stem just upstream of its confluence with the Trask River. Hall Slough would carry approximately 1,000 cfs of floodwater that would also carry sediment that otherwise would be carried by the Wilson River. During small (1.5-year) flood events, flows that would have spread out over the floodplain would remain within the Hall Slough channel, concentrating and increasing the capacity of the slough to carry sediments further downstream.

Long Term

Over the long-term, it is assumed some erosion of new levees would occur, particularly during floods greater than 10-year events. The levees would be designed to pass floods and minimize erosion. Adverse long-term impacts would be minor, local, and less than significant. In addition, erosion of some river bank areas would be expected following the removal of riprap bank protection. This would be considered a beneficial effect, as riprap removal is intended to allow for more natural channel forming processes to occur.

Within the SFC project area, the impacts would be similar to those described under the No Action Alternative. Because the Hall Slough Alternative would only alter Hall Slough and would make no changes in the levees or channels around the bulk of the SFC area, there would be no change in the existing conditions over much of the study area. Over the long-term, the moderate, regional, adverse, long-term impacts on fluvial geomorphology from continued disruption of natural fluvial processes around the SFC area as described for the No Action Alternative would remain unchanged.

Under the Hall Slough Alternative, the slough would be deepened throughout to maintain a positive slope to the bay and to be tidally active throughout its length. The channel form and carrying capacity would be maintained by periodic maintenance dredging. If forces such as sea level rise or changes in the upper watershed were to affect the sediment load or aggradation rates, then the frequency of dredging might be affected, but the flood management function of the alternative over a long-term planning horizon of 40 to 50 years would not be affected.

Alternative 3: Southern Flow Corridor – Initial Alternative

Construction and Transition Period

As with the other two action alternatives, there is a potential for major, local impacts from erosion of soils during construction and during the transition period (1 to 3 years) until vegetation becomes established to stabilize the soil. The potential impacts under Alternative 3 would be the same as described for Alternative 1. Although there would be more levee length and fill material removed under Alternative 3, there would be little difference between the two alternatives with respect to erosion. BMPs related to soil erosion and sedimentation, as described in Section 6, would be required to avoid or reduce soil erosion to a moderate less than significant level.

The potential effects on sediment transport and channel form would also be expected to be similar to the Proposed Action. Alternative 3 would remove levees from around additional lands and additional tidal channels would be expected to form as a result. Because these additional channels would be connected to Hoquarten Slough rather than to the Trask River, they may take longer to reform.

Long Term

Over the long term, floodplain accretion, sediment transport capacity, and channel aggradation would be expected to be similar to the potential results modeled for the Proposed Action. Alternative 3 would also reconnect Hall Slough with Blind Slough with similar expected results on the volume of flow in Hall Slough. Because the setback levees would be in a different configuration under Alternative 3 as compared to the Proposed Action, areas of floodplain accretion might be expected to occur in somewhat different locations, but this difference would be minor.

Over the long term, it is assumed some erosion of new levees would occur, particularly during floods greater than 10-year events. The levees would be designed to pass floods and minimize erosion. Adverse long-term impacts would be minor, local, and less than significant. In addition, erosion of some river bank areas would be expected following the removal of riprap bank protection. This would be considered a beneficial effect, as riprap removal is intended to allow for more natural channel forming processes to occur.

4.7.1.3 Farmland Soils

Farmland soils include soils designated as prime farmland, unique farmland, and land of statewide or local importance. The Farmland Protection Policy Act (7 CFR 658.2(a), (FPPA) is intended to minimize the impact federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses. Projects are subject to FPPA requirements if they may irreversibly convert farmland (directly or indirectly) to nonagricultural use and are completed by a federal agency or with assistance from a federal agency. Farmland subject to FPPA requirements does not have to be currently used for cropland. It can be forestland, pastureland, cropland, or other land but not water or urban built-up land.

FPPA requires federal projects be compatible with state and local programs and policies to protect farmland. The Tillamook County Comprehensive Plan (1982-2004), Land Use Plan (Goal 2) establishes the goal of preserving resource lands, including farmlands. Agricultural

Lands (Goal 3) describes the importance of farmland to the local and regional economy and sets forth polices for its protection.

4.7.1.3.1 Methodology

The methodology used to evaluate impacts to farmlands considered the importance of agriculture to the regional economy and heritage of the study area and compliance with FPPA for protection of farmland of statewide importance. Potential effects of conversion of farmland on the agricultural economy are discussed in Section 4.9.1.

4.7.1.3.2 Affected Environment

The alluvial plain in which the project area is located consists of fertile soils and level areas that were historically forested but have largely been cleared and used for hay and pasture. According to NRCS (2014), lands in the project area are classified primarily as farmland of statewide importance, as shown in **Figure 4.7-3**.

In Tillamook County and other coastal areas, the many days of fog and excessive low cloud cover result in a low evapotranspiration rate and a low number of heat units available for the ripening or maturing of many crops. Although the growing season is considered to be long and the content of soil moisture is adequate to support the growth of crops, few crops can be economically grown and harvested because of the low number of heat units needed for the maturation of most crops. Because of this, the soils in the County and in other coastal areas do not meet the criteria for prime farmland (NRCS 2014).

Farmland of statewide importance is generally land that nearly meets the requirements for prime farmland and that economically produces high yields of crops when treated and managed according to acceptable farming methods (NRCS 2014). Most of the Tillamook Valley is designated as farmland of statewide importance due to its value as pastureland for the significant dairy industry. However, not all areas designated farmland of statewide importance are currently farmed. Some of these lands are forested or are not farmable due to surface water inundation or saturated soils. **Figure 4.7-4** shows land within the study area that is not currently farmed due to forest cover or soil saturation.

4.7.1.3.3 Environmental Consequences

Compliance with the FPPA is determined through an evaluation of the proposed conversion of farmland soils to non-agricultural uses and through consultation with NRCS. Compliance with the FPPA does not require the land be maintained in agricultural uses. It can be forestland or other open lands as long as it is not built over or paved. Impacts to farmland soils would be significant if implementation of an alternative would fail to comply with the FPPA for protection of farmland soils. Generally, compliance with the FPPA is evaluated by completing an NRCS Farmland Conversion Impact Rating Form (NRCS Form AD1006). A score exceeding 160 points would indicate a significant impact.

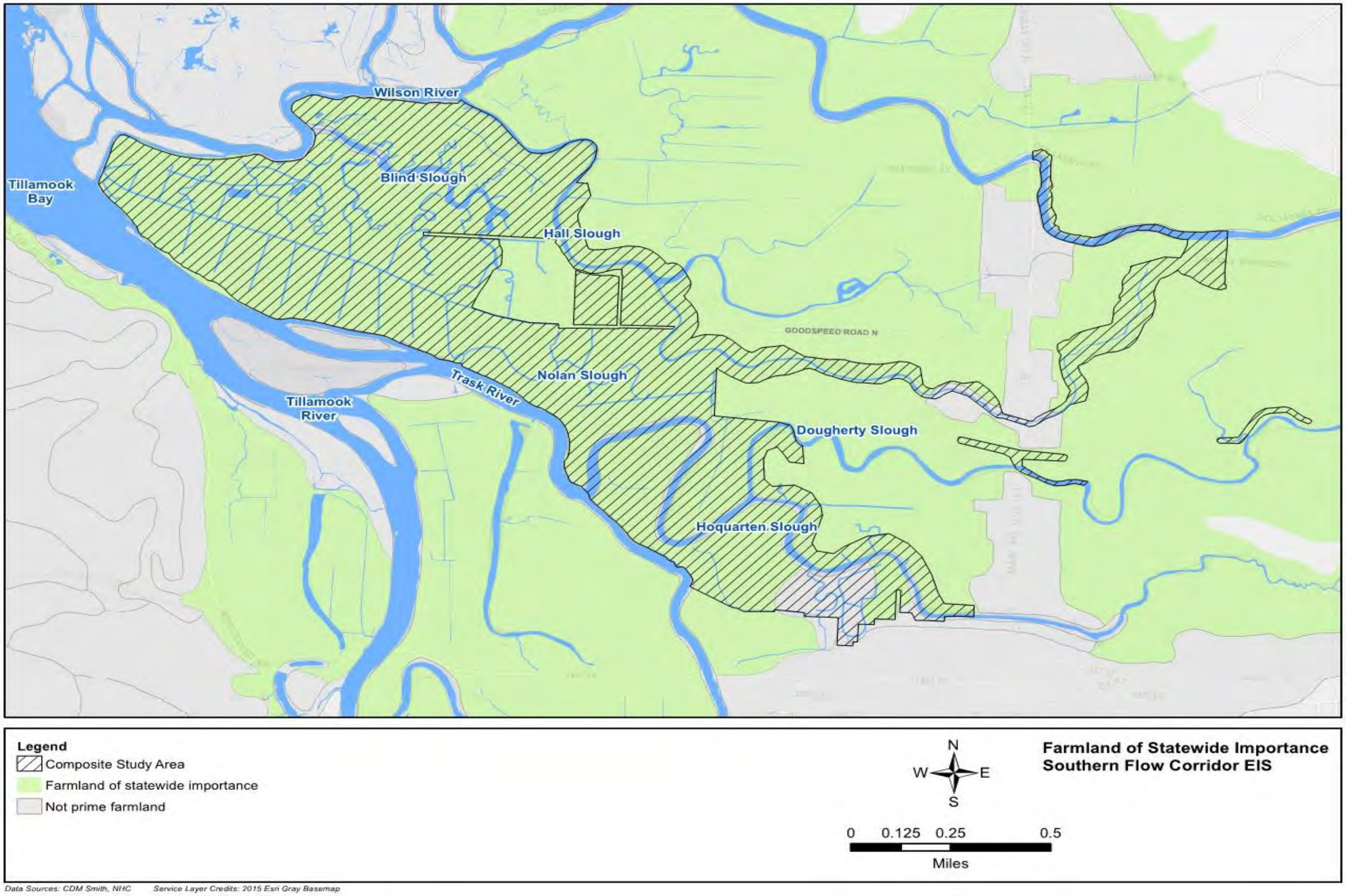


Figure 4.7-3. Farmland of Statewide Importance

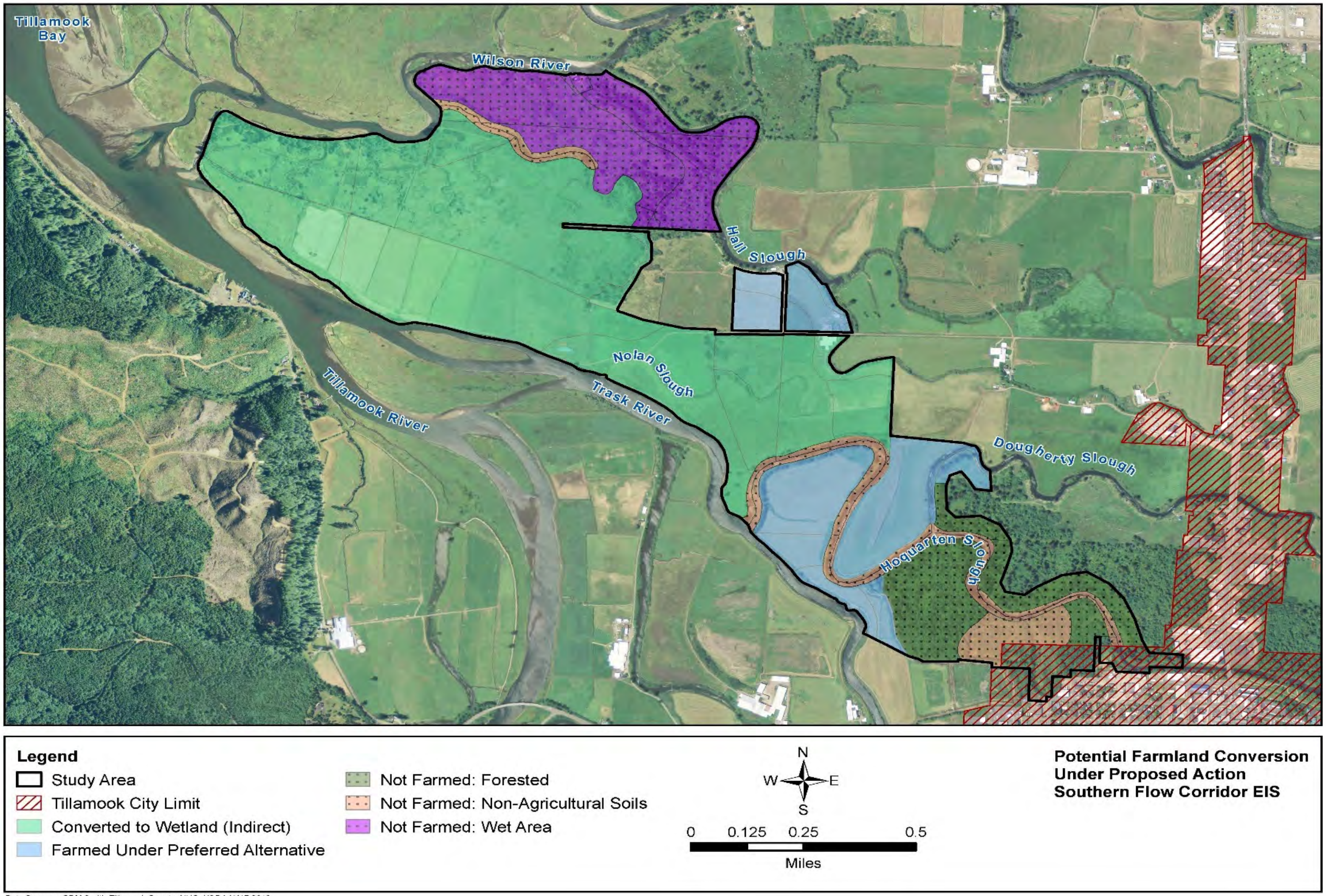


Figure 4.7-4. Potential Farmland Conversion to Wetland under Proposed Action

While compliance with the FPPA does include consideration of the impact of a proposed conversion on the local agricultural economy and the ability of a community to maintain an agricultural infrastructure, those impacts are evaluated in Section 4.9.1, Regional Economics. An impact to farmland soils in the form of FPPA non-compliance is a long-term effect influenced by land management actions taken during all three temporal phases assessed in this EIS. The analysis presented in this section reports the long-term effect of the alternatives. **Table 4.7-1** summarizes the acres of farmland soil and currently farmed land affected by each alternative.

Table 4.7-1. Acres of Farmland Soil and Currently Farmed Land Affected by Alternative

	No Action	Proposed Action	Hall Slough Alternative [3]	Initial Alternative
Total Project Area	392	665.9	98	605.0
Farmland Soil [1] within Alternative	285	453.7	86.4	392.8
Farmland Soil Converted	285	353.7	86.4 [4]	386.6
Area Currently Farmed [2]	151.6	320.3	92.0	259.3
Currently Farmed Area Converted	151.6	219.3	92.0	253.2
Creation of Permanent Water Area	0	0	7.4	0

Notes:

*1 – Farmland soil includes soils of statewide importance outside of City limits. Farmland soil area does not include areas of surface water (sloughs) or areas that are too wet (see **Figure 4.7-4**).*

2 – Currently farmed areas include all areas that are currently in production regardless of location with respect to City limits. Currently farmed areas do not include forested areas, areas that are too wet, surface water, Highway 101, and business district areas.

3 – Hall Slough Alternative values do not include the surface water area of the slough under existing conditions. Other alternatives do not include surface water area.

4 – Total area converted includes 79.0 acres indirectly converted to riparian and wetland habitats and 7.4 acres permanently converted to Hall Slough through widening of the channel.

No Action Alternative

Construction

The No Action Alternative would not affect Farmlands of Statewide Importance. There would be no construction or conversion of farmlands to other uses.

Transition Period and Long Term

The land within the SFC study area that was previously purchased by Tillamook County is required to prohibit agricultural uses under the terms of the grant funding used to purchase the land. Therefore, under the No Action Alternative, it is expected that over time the current agricultural use of the approximately 152 acres leased to local farmers would be phased out of agricultural production. However, this would not constitute non-compliance with the FPPA as the farmland soils would still remain in a protected undeveloped condition. Under the No Action Alternative, the surrounding perimeter levees and system of ditches that help to drain the land would remain in place. While it may be expected that over the long term maintenance of the levees and flood control structures may also be phased out, they would still be expected to be in place for several decades. The NRCS would not consider this to be a conversion of farmland

(Raney 2014). Therefore, there would be no effect on farmland soils under the No Action Alternative.

Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

The Proposed Action was developed in response to concerns about the potential conversion of farmland under the Southern Flow Corridor – Initial Alternative. Multiple potential configurations of levee removal and setback and conveyance easements were considered in coordination with affected landowners to reduce the potential conversion of farmland.

Under the Proposed Action, the pastures on the Aufdermauer and the Trask View Farm parcels would be covered by a flowage easement and would remain in agricultural uses. The parcels in existing County ownership and other areas proposed for wetland restoration would be converted. Of the approximately 666 acres in the project area, approximately 212 acres are not currently farmable or are not farmlands of statewide importance (**Figure 4.7-4**). Of the remaining 454 acres that are farmland of statewide importance, approximately 353 acres, or 78 percent, would be converted to wetlands under the proposed project (**Figure 4.7-4**). The conversion would be considered an indirect effect because the land would remain open and would not be paved. In addition, no development would occur, other than levee construction and modification. As such, the area would remain open, and the farmland soils would not be covered or damaged. FEMA has consulted with NRCS on this proposed indirect conversion, and it would not be a significant impact. The NRCS Form AD1006 score was less than 160 points.

Not all areas designated farmland of statewide importance within the project area are currently farmed. Some of these lands are forested or are not farmable due to surface water inundation or saturated soils. Currently, only approximately 320 acres of the 454 acres of farmland soils are currently farmed. Therefore, this alternative would only convert 68 percent of the land currently farmed to non-farm uses. The potential economic effects that may result from the conversion of farmland are described in Section 4.9.1, Regional Economics. Based on that evaluation, the conversion of farmland associated with the Proposed Action would have a minor, local, long-term adverse impact on the regional economy that would be less than significant. Therefore, the Proposed Action would be in compliance with the FPPA.

Alternative 2: Hall Slough Alternative

For this alternative, converted farmland was considered to include everything inside of the proposed levee modifications. The area within the Hall Slough Alternative project area is approximately 98 acres, excluding approximately 20.7 acres of surface water in the slough. Of that area, approximately 86.4 acres are farmland soils. Areas that are excluded from the total farmland soil acreage include areas located within the City limits, areas that are not farmland of statewide significance, and a small area at the downstream end of the Hall Slough project area that is too wet to be farmed (**Figure 4.7-5**). Land within the urban boundary is not protected under the FPPA.

The widening of Hall Slough under this alternative would create an additional 7.4 acres of surface water area. Because there is little space to widen the slough around Highway 101, it is assumed most of the widening would occur outside of the City limits. Therefore, approximately 7.4 acres of farmland soil would be permanently converted, and 79 acres would be indirectly converted to riparian and wetland land uses within the new setback levees. Although, the conversion would be considered an indirect conversion, because the areas would be small linear strips between the new setback levees and the Hall Slough channel, they would not be as functional for agricultural uses should they be needed in the future. Therefore, the impact on farmlands would be greater than under the No Action Alternative, but would still be a minor, local, adverse impact that would be less than significant.

Some of the land within the City limits is currently farmed, and there is approximately 92 acres of currently farmed land within the Hall Slough Alternative project area (**Figure 4.7-6**). Under the Hall Slough Alternative, the entire 92 acres would be converted to wetland and riparian uses. This acreage excludes areas that are currently too wet to farm, Highway 101, and the business district. Potential adverse effects on the regional economy from the conversion of 92 acres of farmland would be a minor, local, adverse impact that would be less than significant.

The land within the SFC study area that was previously purchased by Tillamook County is required to prohibit agricultural uses under the terms of the grant funding used to purchase the land. Therefore, under Alternative 2, it is expected that over time the current agricultural use of the approximately 152 acres leased to local farmers would be phased out of agricultural production. However, this would not constitute non-compliance with the FPPA as the farmland soils would still remain in a protected undeveloped condition.

Alternative 3: Southern Flow Corridor – Initial Alternative

Alternative 3 would not maintain agricultural uses in any of the project area. The biggest difference between Alternative 3 and Alternative 1 is the pastures included under a flowage easement in Alternative 1 would be converted to tidal wetlands under Alternative 3. Of the approximately 605 acres in the Alternative 3 project area, approximately 212 acres are not currently farmable or are not farmlands of statewide importance (**Figure 4.7-7**). Approximately 387 acres of the remaining 393 acres that are farmland of statewide importance, or 98 percent, would be converted indirectly to wetlands under the proposed project.

In addition, no development would occur other than levee construction and modification. As such, the area would remain open, and the farmland soils would not be covered or damaged. The conversion would be considered an indirect effect because the land would remain open and would not be paved. Although there has been no consultation with NRCS specific to this alternative, farmland conversion would be similar to the Proposed Action. Therefore, Alternative 3 would be in compliance with the FPPA, and the conversion would be a minor, local, long-term adverse impact that would be less than significant.

Of the 393 acres of farmland soils, only approximately 260 acres are currently farmed (**Figure 4.7-7**). Approximately 253 acres, or 97 percent, of the currently farmed land would be converted to tidal wetlands. Effects on the regional agricultural economy are described in Section 4.9.1 and would be less than significant.

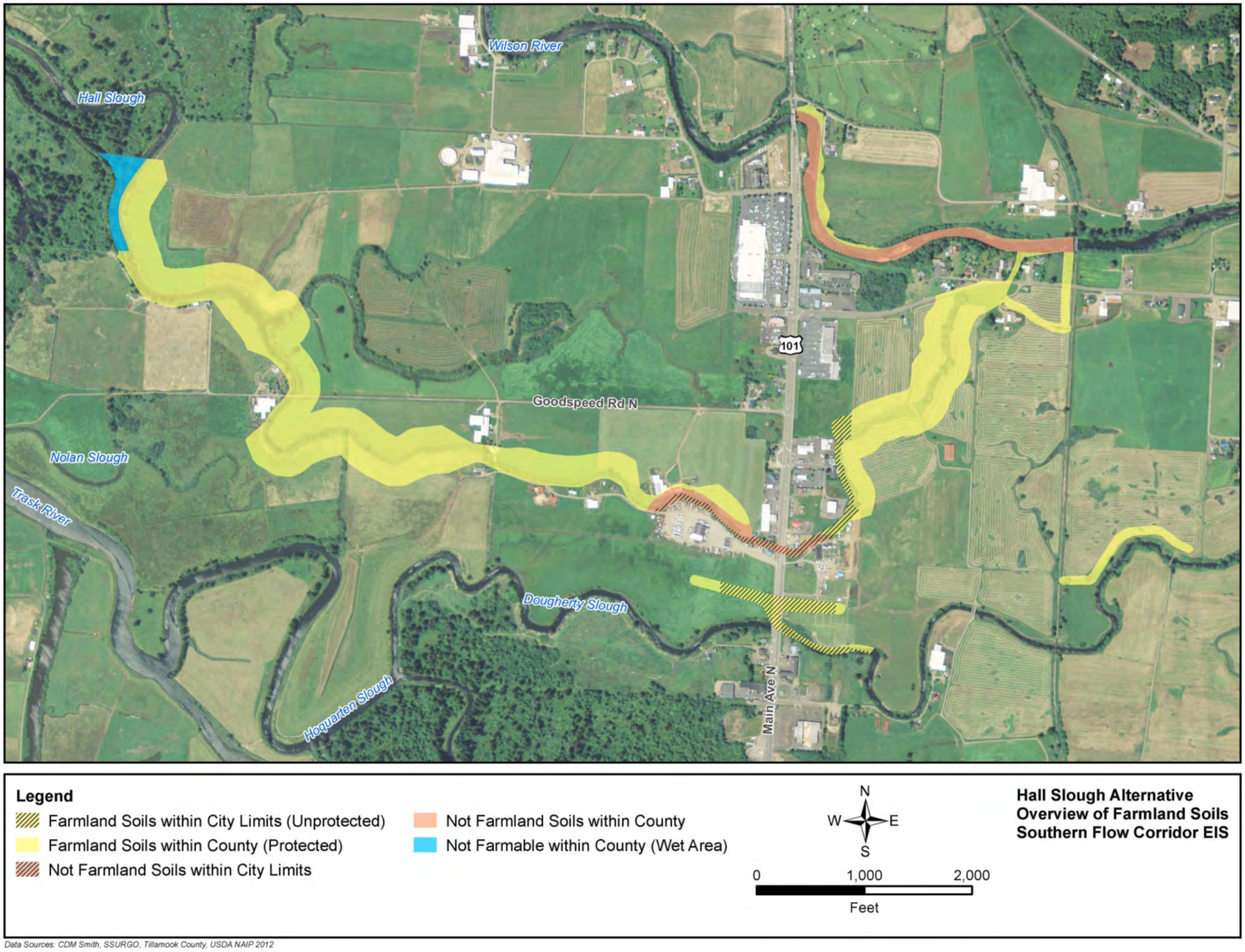


Figure 4.7-5. Farmland Soils within the Hall Slough Alternative Project Area

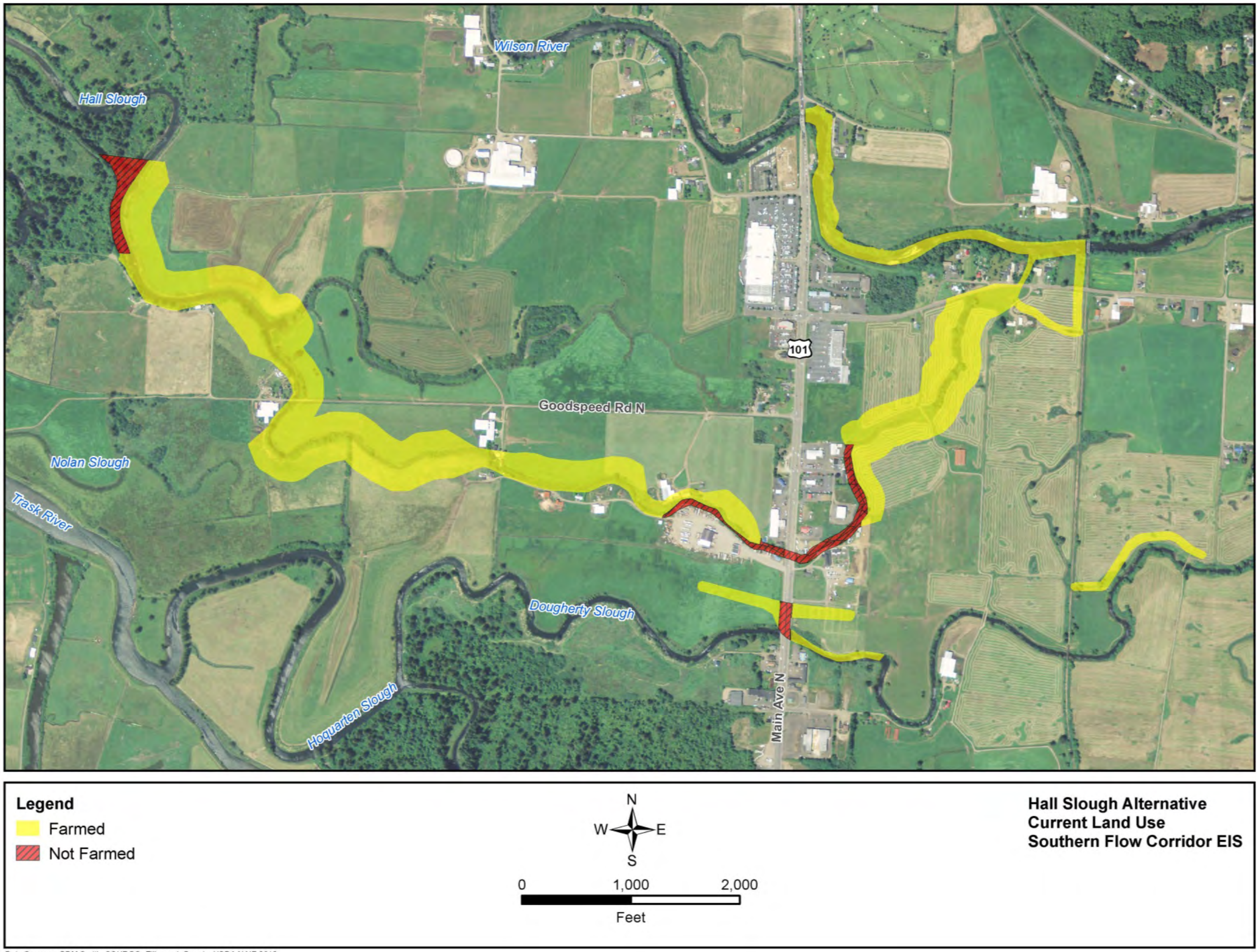


Figure 4.7-6. Currently Farmed Lands within the Hall Slough Alternative Project Area

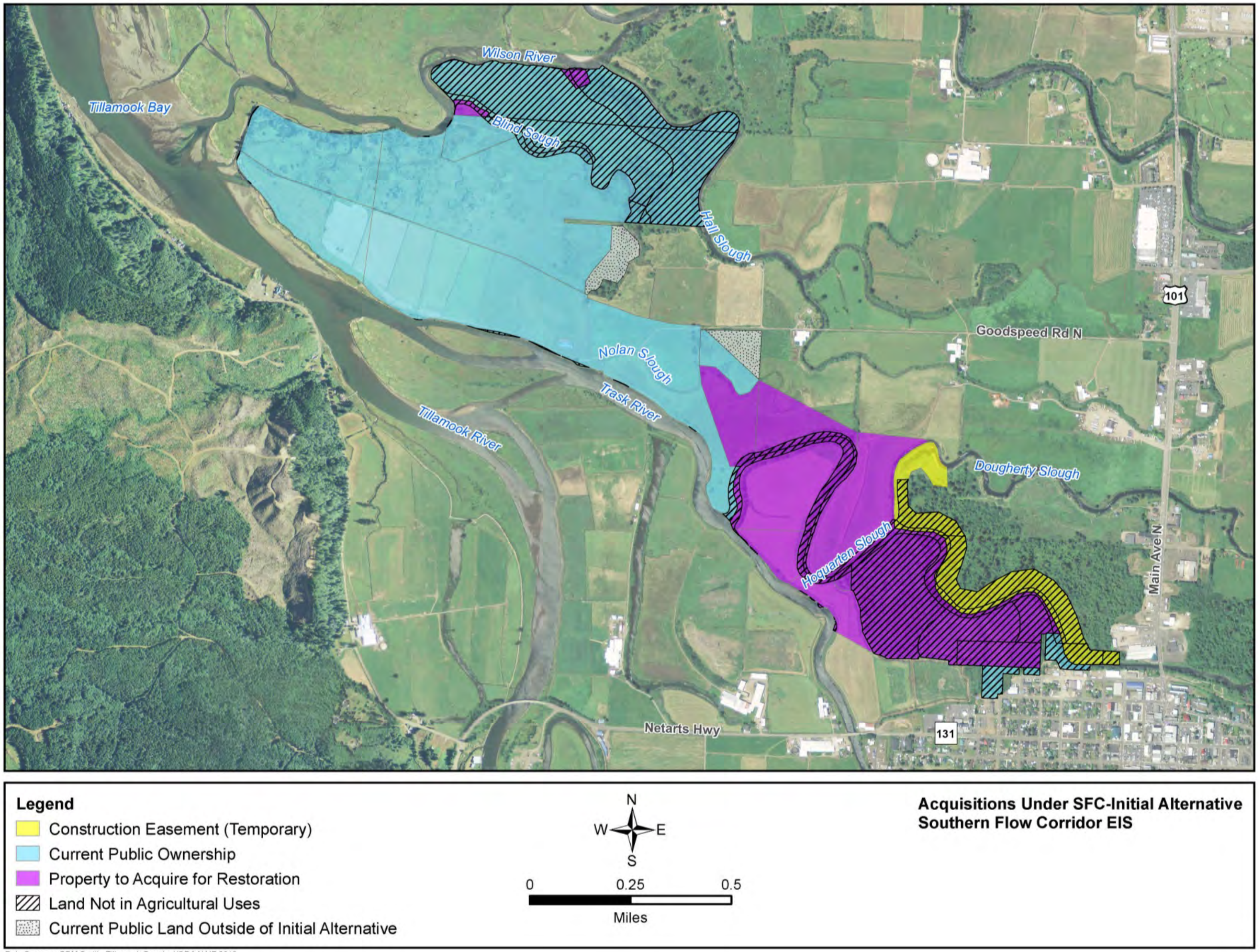


Figure 4.7-7. Potential Farmland Conversion under the Initial Alternative

4.7.2 Coastal Resources

Coastal resources in the project area include habitat for important coastal fisheries, including coho and chum salmon, steelhead, and cutthroat trout. Coastal resources also include the features that benefit tourism and recreation. Recognizing the importance of coastal resources, the CZMA (P.L. 92-583), as implemented by 15 CFR Part 930, requires federal agencies to determine whether proposed activities that affect any land or water use or natural resource within the coastal zone shall be carried out in a manner consistent, to the maximum extent practicable, with the enforceable policies of approved state management programs. This means projects with federal funding or requiring federal approvals must be consistent with the Oregon Coastal Management Program and the Tillamook County and City comprehensive plan policies and goals that implement the Oregon statewide planning goals for the management of estuarine resources (Goal 16), coastal shorelands (Goal 17), beaches and dunes (Goal 18), and ocean resources (Goal 19). The local comprehensive plan policies recognize the value of coastal marshes, wetlands, and estuarine habitats and encourage uses that maintain the integrity of the estuarine ecosystem. Implementation of Goal 17 also prioritizes the restoration of degraded habitats where appropriate. These state and local policies and plans are described in more detail in Appendix C.

4.7.2.1 Methodology

The methodology for evaluating impacts to coastal resources under the project alternatives includes consideration of the regulatory setting and how the project alternatives comply with applicable laws and regulations that protect coastal resources. Coastal resources are associated with a range of topics, including biological resources (Section 4.6), water resources (Section 4.5), and regional economics (Section 4.9.1), which are described in detail in the respective sections of this EIS. Impacts on specific resources from the action alternatives are evaluated in those sections.

For the purposes of this section, impacts to coastal resources were evaluated based on compliance with the CZMA and the state and local land use planning policies developed for the Tillamook study area based on the requirements of the CZMA. Therefore, this section only considers potential long-term impacts related to any alterations of land use of the study area under the project alternatives.

4.7.2.2 Affected Environment

The coastal zone of Oregon extends from the ocean to the crest of the Coast Mountain Range. The study area is within the coastal zone of the State of Oregon and includes portions of the City of Tillamook, Tillamook Bay, and the five rivers that are tributaries to the Tillamook Bay. Tillamook Bay supports an oyster aquaculture industry, a commercial/recreational port, and a recreational salmon fishery (TBNEP 1999).

Tillamook Bay is designated by DLCD as a “Shallow Draft Development Estuary,” which is an estuary “with maintained jetties and a main channel (not entrance channel) maintained by dredging at 22 feet or less.” Bathymetry data generally indicate Tillamook Bay and the lower reaches of the Trask, Tillamook, and Wilson rivers are aggrading generally, and in some areas, the amounts are substantial (see Section 4.7.1.2 and Appendix E and Appendix J). Dredging of Tillamook Bay is conducted for navigation purposes.

Despite the bay's classification as a "development" estuary, the County's Comprehensive Plan emphasizes conservation of the bay's resources and the long-term stability of life that depends on it. This is reflected in the ordinances that govern the bay, and the land use map that designates much of the bay as "estuary natural." Classifications under the Tillamook County Land Use Ordinance include:

- **Estuary Conservation 1 (EC1).** EC1 areas are designated to (1) "provide for long-term utilization of areas which support, or have the potential to support valuable biological resources, and (2) provide for long-term maintenance and enhancement of biological productivity and aesthetic values." EC1 areas possess significant habitat values in the forms of tidal marshes, tideflats, seagrasses, and algae beds. This zone comprises much of the interface between terrestrial and aquatic habitats. The following EC1 units are located within the City of Tillamook urban growth boundary (City of Tillamook 1990):

    a. Unit 35EC1: This unit consists of the Wilson River. Significant biological functions associated with this management unit include foraging habitat and fish passage for salmonids.

    b. Unit 36EC1: This unit bounds the portions of Dougherty and Hall sloughs that are in or adjacent to the urban growth boundary. Significant biological functions associated with this management unit include bird use of adjacent riparian areas.

    c. Unit 40EC1: This unit bounds Hoquarten and Dougherty sloughs west of Highway 101 to the confluence with the Tillamook River. Significant biological functions associated with this management unit include foraging habitat for fish and bird nesting of adjacent riparian and marsh habitats.

    d. Unit 41EC1: This unit is located in the vicinity of the historic mill at the Sadri property. Significant biological functions associated with this management unit include bird foraging, resting, and nesting habitat.

    e. Unit 43EC1: This unit bounds the Trask River from the head of tide near the Highway 101 Bridge to Hoquarten Slough. Significant biological function associated with this management unit is fish passage for salmonids.

- **Estuary Conservation 2 (EC2).** EC2 areas "provide for long-term use of renewable resources that do not require major alterations of the estuary except for purposes of restoration." Habitat areas are recognized as partially altered and do not qualify for inclusion in EC1 or estuary natural (EN). The Tillamook River south of the project area is designated EC2.

- **Estuary Development (ED).** ED areas are "designated for navigational and other water-dependent commercial, industrial, or recreational uses." Habitat features are considered to be minimal. This zone is only found in and around development near the bay.

- **Estuary Conservation Aquaculture (ECA).** "The purpose of the ECA Zone is to promote the continuing utilization of designated shellfish culture areas while providing for low-intensity, water-dependent recreation, commercial and recreational fishing and crabbing." Habitat values are recognized as high and are protected for "scientific, research, or educational purposes."

- **Estuary Natural (EN).** EN areas are designated to "provide for preservation and protection of significant fish and wildlife habitats and other areas, which make an essential contribution to estuarine productivity or fulfill scientific, research, or educational needs." Most of Tillamook Bay is classified EN except for a significant tract of ECA in the Main Bay and ED zones near urbanized areas.

These land use classifications in the study area are shown on **Figure 4.7-8**.

State planning goals for estuaries and shorelands (Goals 16 and 17, respectively) apply to the project area. Goal 16 applies because the project area contains estuarine resources, identified as estuary management units, as described above and identified in the Tillamook County Comprehensive Plan.

Goal 17 applies because the study area is included in the area defined in ORS 366.235 as coastal shorelands: "northerly along State Highway 131 to its junction with the Oregon coast Highway near Tillamook."

4.7.2.3 Environmental Consequences

Impacts related to coastal resources were evaluated for each of the project alternatives, with a focus on whether the alternative would be consistent with the CZMA and state and local goals and policies for designated estuaries and shorelands. Potential impacts are described consistent with the impact evaluation criteria presented in **Table 4.1-1**. An impact to coastal resources in the form of consistency with the CZMA and state and local goals and policies for designated estuaries and shorelands is a long-term effect influenced by land management actions taken during all three temporal phases assessed in this EIS. The analysis presented in this section reports the long-term effect of the alternatives. An impact would be considered significant if the alternative would not be consistent with the CZMA and adopted local plans and policies.

4.7.2.3.1 No Action Alternative

Construction, Transition Period, and Long Term

The No Action Alternative would not alter either the estuary waters or coastal shorelands and would generally be in compliance with the CZMA. However, the No Action Alternative would also not restore natural estuary habitats and would allow the existing degraded condition with respect to water and biological resources to continue, as described in Sections 4.5 and 4.6, respectively. Therefore, over the long term, the No Action Alternative would not meet the goals of the County Comprehensive Plan or the state planning goals, which would represent a moderate, regional, significant impact on coastal resources.

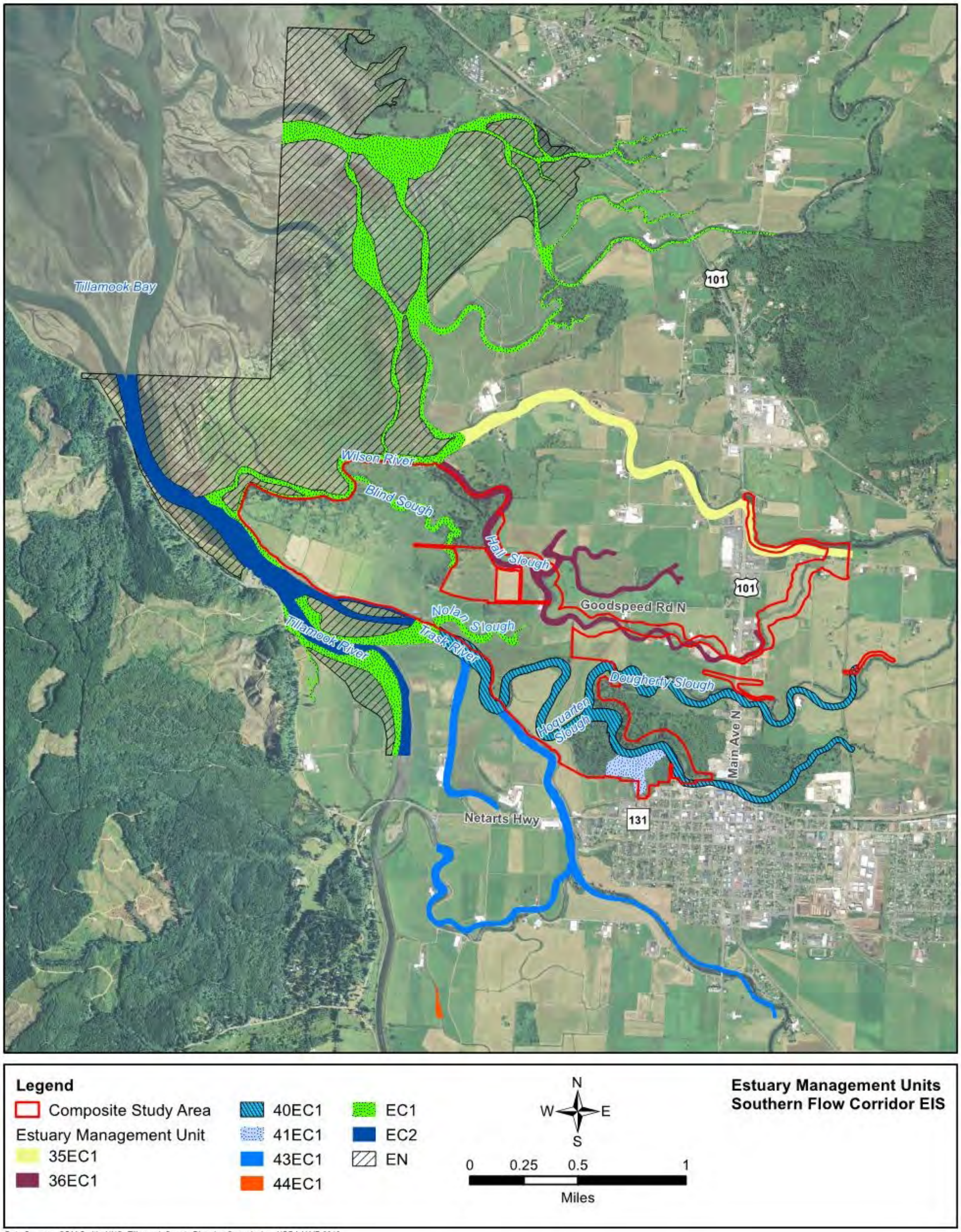


Figure 4.7-8. Estuary Management Units in the Study Area

4.7.2.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

The Proposed Action would enhance coastal resources by restoring natural tidal processes and improving water quality, wetlands, and habitat in the project area. A new connector channel would improve the hydraulic connectivity between Hall and Blind sloughs, and new tide gate structures and modifications to existing drainage ditches would improve drainage of flood flows.

Restoration of tidal wetlands would promote restoration and protection of estuary resources, particularly biological resources such as fisheries, shellfish, and birds. The restoration activities would be consistent with navigational and other water-dependent commercial, industrial, or recreational uses and represent major, regional, long-term beneficial effects.

Important coastal resources, including fisheries and shellfish resources, are also expected to benefit from implementation of the Proposed Action, as discussed in Section 4.9.1, Regional Economics, Section 4.6.2, Fish and Wildlife, and Section 4.9.4, Recreation. These resources will benefit from improvements in available habitat and water quality (Section 4.6.2 and Section 4.5.4, respectively).

Lands that would be restored as tidal wetlands under the Proposed Action are not currently designated as estuary management units. However, adjacent lands have been designated EN, and the surrounding rivers and sloughs have EC1 and EC2 designations (**Figure 4.7-8**). The proposed design of the new setback levees would be required to meet guidelines consistent with zoning. The Proposed Action would be consistent with the goals for protection and restoration of natural resource values in the estuary, and the Proposed Action would not be inconsistent with the surrounding zones. Consistency with the local land use plans and the CZMA would be confirmed by Tillamook County at the time of final design and permit approvals. Therefore, the Proposed Action would be in compliance with the CZMA, and there would be no adverse impacts to coastal resources.

4.7.2.3.3 Alternative 2: Hall Slough Alternative

Under the Hall Slough Alternative, some tidal wetland restoration would occur between the setback levees and the new widened channel, which would be a moderate, regional, long-term beneficial effect. This would benefit fish and wildlife habitat and improve fish passage, ecosystem and floodplain functions, and water quality. The proposed design of the levees would be required to meet guidelines consistent with zoning. The Hall Slough Alternative would be consistent with the goals for protection and restoration of natural resource values in the coastal zone. Therefore, Alternative 2 would be in compliance with the CZMA, and there would be no adverse impacts on coastal resources.

4.7.2.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Alternative 3 would benefit estuary and coastal resources similar to the Proposed Action. The amount of tidal wetlands restored would be somewhat greater than under the Proposed Action, but most other effects on coastal resources would be very similar, represent major, regional, long-term beneficial effects.

The design of the new setback levees would be required to meet guidelines consistent with zoning. Consistency with the local land use plans and the CZMA would be confirmed by Tillamook County at the time of final design and permit approvals. Therefore, Alternative 3 would be in compliance with the CZMA, and there would be no adverse impacts on coastal resources.

4.7.3 Air Quality

Construction activities have the potential to affect air quality through emissions from heavy equipment and from particulates generated from dust from disturbed soils. This section presents a brief summary of the current regulatory setting and information on existing air quality conditions in Tillamook County, Oregon, and evaluates potential impacts on air quality from each alternative. Greenhouse gases (GHGs) are discussed separately in Section 4.7.4, Climate Change.

In response to concerns about air pollutants and GHGs, federal legislators have passed statutes that mandate control of ambient pollutants, and federal agencies have adopted rules and regulations to implement these laws.

The Clean Air Act (40 CFR 51) is the federal statute that addresses criteria pollutants and sets the National Ambient Air Quality Standards (NAAQS). EPA sets the NAAQS that define maximum pollution levels in air that are still protective of human health and welfare and develops emission standards for sources of air pollutants to reduce pollutant emissions to the atmosphere. Under the authority granted by the CAA, EPA has established NAAQS for the following criteria air pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3)[3], particulate matter 10 micrometers (µm) or less in diameter (PM_{10}), particulate matter 2.5 µm or less in diameter ($PM_{2.5}$)[4], and sulfur dioxide (SO_2).

EPA has also promulgated a set of regulations, known as the general conformity rule that includes procedures and criteria for determining whether a proposed federal action would conform to the applicable state implementation plans. The purpose of the general conformity rule is to ensure federal activities do not cause or contribute to new violations of the NAAQS, actions do not cause additional or worsen existing violations of or contribute to new violations of the NAAQS, and attainment of the NAAQS is not delayed.

The state Ambient Air Quality Standards (OAR, Chapter 340, Division 202) are established by the State of Oregon. The ambient standards set forth in OAR 340-202-0050 through 340-202-0130 were established to protect public health and public welfare.

Appendix C provides additional information on air quality regulations, and Appendix H provides additional detail on the criteria used to set thresholds of significance, the methodology used in the analysis, and the calculations of potential emissions.

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[3] *Ozone (smog) is a secondary pollutant, meaning it is formed in the atmosphere through a reaction of precursor compounds in the presence of sunlight. The important precursors for O_3 formation are oxides of nitrogen (NOx) and VOCs. Air quality impact analyses for O_3 typically assess the increase in emissions of NOx and VOC.*

[4] *$PM_{2.5}$ is made up of directly emitted particulate matter as well as secondary particulate matter formed through reactions of precursor compounds. The important gaseous precursors for $PM_{2.5}$ formation are NOx, VOC, sulfur oxides (SOx), and ammonia (NH_3).*

4.7.3.1 Methodology

Standard emission estimation models approved by EPA were used to estimate emissions from proposed construction activities associated with the action alternatives. The majority of the potential emissions would be from nonroad equipment used during construction activities. The factors for engine exhaust and fugitive dust were used with estimated activity levels, such as number of pieces of equipment, number of days of active operation, disturbed acreage, and vehicle miles traveled to determine total emissions of criteria air pollutants.

The construction activity emissions were estimated using the appropriate emission factor models and spreadsheet calculations. The following construction sources and activities were analyzed for emissions:

- Onsite construction equipment emissions with NONROAD2008a (EPA 2009)
- Offsite haul truck engine emissions with MOVES2014-20141021 (EPA 2014a)
- Offsite worker vehicle trips to and from the sites with MOVES2014-20141021 (EPA 2014a)
- Entrained fugitive dust emissions for paved road travel (EPA 2011)
- Fugitive dust emissions from grading, bulldozing, and material handling activities (EPA 1998b; EPA 2006)

Appendix H provides additional information on these emission calculation methodologies and results.

4.7.3.2 Affected Environment

The existing air quality and meteorological conditions in Tillamook County were developed from monitoring data collected by regulatory agencies at air quality and meteorology stations near the study area.

4.7.3.2.1 Meteorology and Climate

Tillamook County is located in Climate Division 1 (Oregon Coast), as established by the National Climatic Data Center. Weather in Oregon's Pacific Coast is defined by wet winters, dry summers, and mild temperatures. Temperatures are relatively consistent, with the average annual temperature only about 15 degrees above the coldest month. Normal annual precipitation ranges from 65 to 90 inches along the lower elevations but can reach 200 inches in higher elevations. Highest monthly precipitation typically occurs during the winter months of November, December, and January. While some of the higher elevations in the surrounding ranges may receive significant snowfall, snowfall along the coast is minimal (Taylor et al. No Date).

4.7.3.2.2 Existing Ambient Air Quality

ODEQ does not maintain a monitoring network in Tillamook County. Rather, ODEQ maintains Oregon's monitoring network primarily in areas designated as maintenance or nonattainment of the NAAQS. Additionally, ODEQ has monitors in attainment areas with fast growing populations. Tillamook County is designated as in attainment for all pollutants (40 CFR 81.338); thus, representative monitoring data are not available for the area.

4.7.3.3.3 Class I Areas

Under the CAA, Class I areas are protected areas of natural wonder and scenic beauty, such as national parks, national monuments, and wilderness areas, where air quality is given special protection. If a source of air impacts is located within 100 kilometers of a Class I area, then it is generally recommended a visibility impact analysis be completed to determine if there could be any adverse effects on visibility in Class I areas. Although several Class I areas are located in the Cascade Mountain range to the east of the study area, none of them are located within 100 kilometers of the study area. **Figure 4.7-9** shows the location of the nearest Class I areas in relationship to the study area.

4.7.3.3 Environmental Consequences

This section discusses the potential effects of the action alternatives and the No Action Alternative on air quality near the study area. Because the action alternatives occur in a region designated as in attainment for all pollutants, the criteria for determining whether a significant adverse impact could occur are based on the definition of a major stationary source in an attainment area (40 CFR 52.21(b)(1)(i)) under the Prevention of Significant Deterioration (PSD) program. These thresholds were developed for stationary sources that could operate at a single location for decades; therefore, these thresholds would be conservative when applied to the temporary activities associated with the action alternatives and the No Action Alternative. It could be reasonably assumed the impact from sources with emissions less than these thresholds would not be adverse or significant.

The PSD definition of a major source has two categories: specifically defined facilities listed in 40 CFR 52.21(b)(1)(i)(a), which are given a major source emission rate of 100 tons per year; and all other facilities, which are given a major source emission rate of 250 tons per year (40 CFR 52.21(b)(1)(i)(b)). To be conservative, the lower threshold is used for this analysis.

4.7.3.3.1 No Action Alternative

Construction

Under the No Action Alternative, the proposed flood damage reduction and ecosystem restoration actions would not be funded, and the project actions would not be implemented. As a result, there would be no construction activities, and air emissions would not occur.

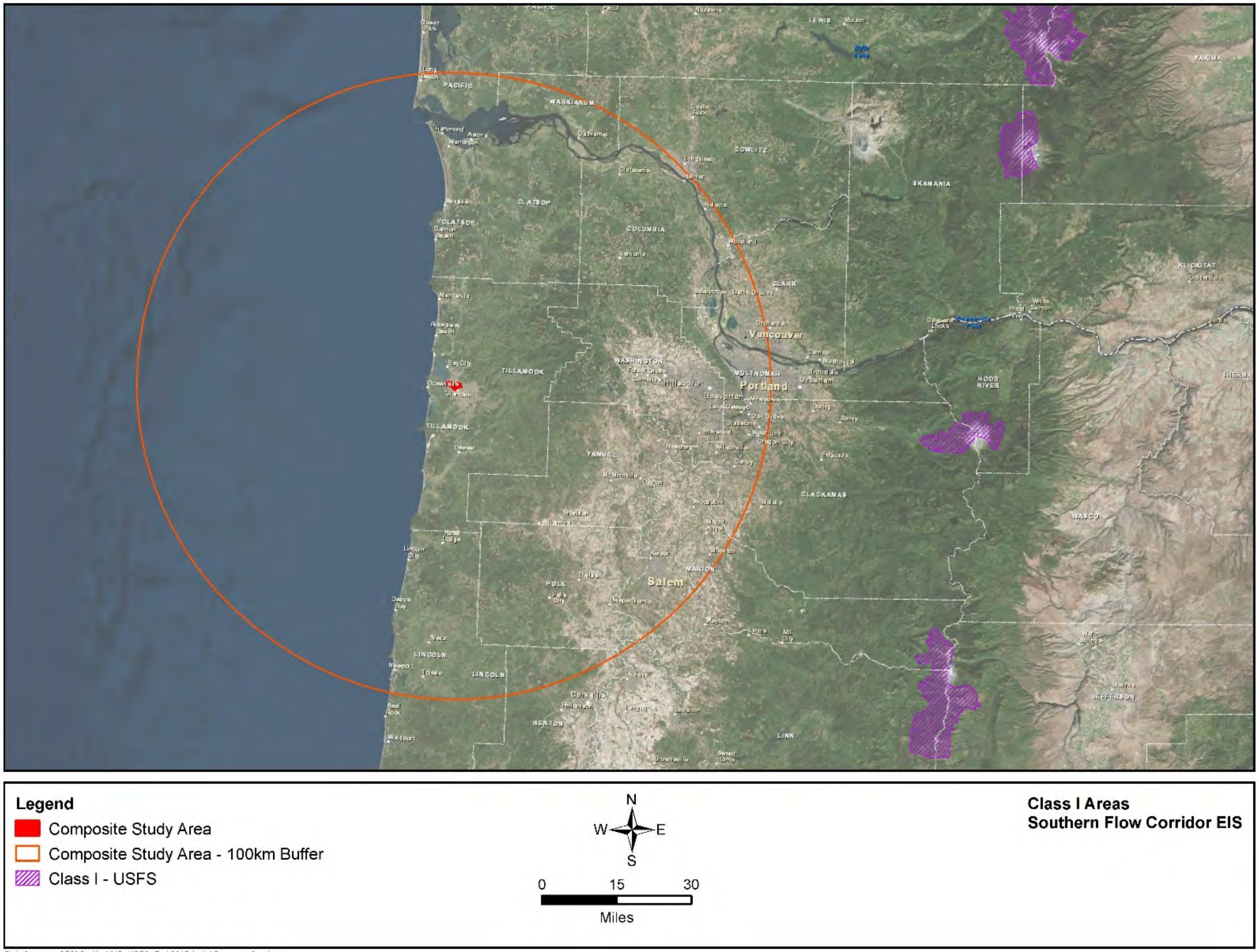
Transition Period and Long Term

There would be no effect on air quality over the long-term under the No Action Alternative.

4.7.3.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Construction

Under the Proposed Action, sections of existing levees would be removed and modified, and new setback levees would be constructed as described in Section 3. Criteria pollutant emission sources would include exhaust emissions from off-road construction equipment, on-road haul trucks, construction worker employee commuting vehicles, and fugitive dust emissions from paved roads and earthmoving activities. Earthmoving activities that could generate fugitive dust include grading, bulldozing, and material handling activities.



Data Sources: CDM Smith, NHC, USFS, Esri 2015 Aerial Basemap Service

Figure 4.7-9. Location of Class I Areas near Study Area

Detailed construction information, including the quantity and type of construction equipment, quantity of material imported or exported from the construction sites, total graded area, and the construction schedule, were provided by the project applicant (see Appendix H for detailed calculations). **Table 4.7-2** summarizes predicted uncontrolled annual emission rates for VOC, NOx, CO, SO_2, PM_{10}, and $PM_{2.5}$ for the Proposed Action.

As shown in the table, emissions from all pollutants would be less than 100 tons per year. Adverse impacts related to criteria pollutant emissions from implementation of the Proposed Action would be minor, local, and less than significant, and mitigation would not be required.

Table 4.7-2. Total Emissions by Source Type (Proposed Action)

Source	Project Emissions (tons per year)					
	VOC	NOx	CO	SO_2	PM_{10}	$PM_{2.5}$
Construction Equipment Exhaust	1.08	12.89	5.14	0.016	0.68	0.66
Haul/Vendor Truck Exhaust	0.080	0.36	0.91	0.0014	0.025	0.016
Construction Worker Exhaust	0.033	0.046	0.34	0.00053	0.0026	0.00091
Parking Lot Construction	0.0083	0.054	0.030	0.000061	0.0049	0.0048
Grading	--	--	--	--	0.10	0.011
Bulldozing	--	--	--	--	0.46	0.25
Material Handling	--	--	--	--	0.051	0.0077
Paved Road Dust	--	--	--	--	0.26	0.064
Total	**1.20**	**13.35**	**6.42**	**0.018**	**1.59**	**1.02**

Key:
-- = zero emissions
VOC = volatile organic compound
NOx = nitrogen oxides
CO = carbon monoxide
SO_2 = sulfur dioxide
PM_{10} = particulate matter less than 10 micrometers
$PM_{2.5}$ = particulate matter less than 2.5 micrometers

As discussed in Section 3.4.2, a temporary trestle or pontoon bridge could be constructed over Hoquarten Slough. It is expected there could be additional haul truck and construction worker trips to construct the bridge. Although there would be an increase in emissions beyond that shown in **Table 4.7-2**, the incremental emissions increase would be minor and would not cause an adverse impact.

Although short-term fugitive dust emissions could occur during construction activities, no Class I areas are located near the study area, and so a detailed visibility analysis is not required. The Mount Hood Wilderness area is the closest Class I area to the study area, and it is located approximately 150 kilometers to the east. Additionally, any construction activities would be conducted in compliance with OAR 340-208-0010, which contains requirements related to visible emissions. Reasonable precautions to minimize fugitive dust emissions would be used by construction contractors, such as water application, thereby limiting fugitive dust emissions. Any adverse effects from fugitive dust emissions on nearby residents would be minor, local, and less than significant.

Transition Period and Long Term

No transition-period or long-term operational effects would occur from implementation of this alternative. All potential air quality impacts would occur during the construction phase. Maintenance of the levees would be expected to require significantly less equipment and time to accomplish than the initial construction.

4.7.3.3.3 Alternative 2: Hall Slough Alternative

Construction

Under Alternative 2, sections of existing levees would be modified, new setback levees would be constructed, and Hall Slough would be widened and deepened as described in Section 3. Construction details (e.g., type and quantity of construction equipment) and the construction schedule were estimated based on information provided by the project applicant (see Appendix H for detailed calculations). Because the amount of levee work would be considerably less than that required for the Proposed Action, the construction schedule for Alternative 2 was assumed to be half of the duration of the Proposed Action. **Table 4.7-3** summarizes the predicted annual emissions associated with construction activities that would occur during implementation of Alternative 2.

Table 4.7-3. Total Emissions by Source Type (Alternative 2)

Source	Project Emissions (tons per year)					
	VOC	NOx	CO	SO_2	PM_{10}	$PM_{2.5}$
Construction Equipment Exhaust	0.52	6.23	2.47	0.0077	0.33	0.32
Haul/Vendor Truck Exhaust	0.037	0.17	0.43	0.00064	0.012	0.0075
Construction Worker Exhaust	0.016	0.022	0.16	0.00025	0.0012	0.00043
Grading	--	--	--	--	0.035	0.0038
Bulldozing	--	--	--	--	0.23	0.13
Material Handling	--	--	--	--	0.0025	0.00037
Paved Road Dust	--	--	--	--	0.12	0.030
Total	**0.58**	**6.42**	**3.05**	**0.0086**	**0.73**	**0.49**

Key:
-- = zero emissions
VOC = volatile organic compound
NOx = nitrogen oxides
CO = carbon monoxide
SO_2 = sulfur dioxide
PM_{10} = particulate matter less than 10 micrometers
$PM_{2.5}$ = particulate matter less than 2.5 micrometers

As shown in **Table 4.7-3**, criteria pollutant emissions would be less than those estimated for the Proposed Action (see **Table 4.7-2**), which are less than the significance threshold of 100 tons per year for each pollutant. Adverse impacts related to criteria pollutant emissions from implementation of Alternative 2 would be minor, local, and less than significant, and mitigation would not be required.

Transition Period and Long Term

No transition-period or long-term operational effects would occur from implementation of this alternative. All potential air quality impacts would occur during the construction phase. Maintenance of the levees would be expected to require significantly less equipment and time to accomplish than the initial construction. Maintenance dredging of the channel would also be expected to require much less time than the initial construction, which also includes deepening and widening the channel.

4.7.3.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction

Under Alternative 3, proposed construction activities would be similar to those of the Proposed Action and are described in Section 3. Construction details (e.g., type and quantity of construction equipment) and the construction schedule were estimated from information provided by the project applicant (see Appendix H for detailed calculations). Because the amount of levee work would be approximately equal to the Proposed Action, the construction schedule for Alternative 3 was assumed to be equal to that provided for the Proposed Action. **Table 4.7-4** summarizes the predicted annual emissions associated with construction activities that would occur during implementation of Alternative 3.

Table 4.7-4. Total Emissions by Source Type (Alternative 3)

Source	Project Emissions (tons per year)					
	VOC	NOx	CO	SO_2	PM_{10}	$PM_{2.5}$
Construction Equipment Exhaust	1.08	12.89	5.14	0.016	0.68	0.66
Haul/Vendor Truck Exhaust	0.078	0.36	0.89	0.0013	0.025	0.016
Construction Worker Exhaust	0.033	0.046	0.34	0.00053	0.0026	0.00091
Parking Lot Construction	0.0083	0.054	0.030	0.000061	0.0049	0.0048
Grading	--	--	--	--	0.10	0.011
Bulldozing	--	--	--	--	0.46	0.25
Material Handling	--	--	--	--	0.014	0.0021
Paved Road Dust	--	--	--	--	0.25	0.063
Total	**1.20**	**13.34**	**6.40**	**0.018**	**1.55**	**1.02**

Key:
-- = zero emissions
VOC = volatile organic compound
NOx = nitrogen oxides
CO = carbon monoxide
SO_2 = sulfur dioxide
PM_{10} = particulate matter less than 10 micrometers
$PM_{2.5}$ = particulate matter less than 2.5 micrometers

As shown in **Table 4.7-4**, criteria pollutant emissions would be less than those assumed for the Proposed Action (see **Table 4.7-2**), which are less than the significance threshold of 100 tons per year for each pollutant. Adverse impacts related to criteria pollutant emissions from implementation of Alternative 3 would be minor, local, and less than significant, and mitigation would not be required.

Transition Period and Long Term

No transition-period or long-term operational effects would occur from implementation of this alternative. All potential air quality impacts would occur during the construction phase.

Maintenance of the levees would be expected to require significantly less equipment and time to accomplish than the initial construction.

4.7.4 Climate Change

Climate change is predicted to result in increased temperature, changes to seasonal precipitation, sea level rise and storm surge, reduced snowpack, reduced warm-season runoff, increased heavy precipitation, and increased number of extreme heat days. The current Intergovernmental Panel on Climate Change (IPCC) predictions for global sea level rise by 2100 are from 1.5 to 2.7 feet (Field et al. 2014). Levee and diking projects in coastal environments raise issues of long-term effectiveness in the face of anticipated climate change and sea level rise. This analysis evaluates the applicant's assessment of the effect of sea level rise on the proposed project area. The evaluation qualitatively extrapolates that evaluation to the other alternatives to review the ability of each alternative to provide community resiliency into the future. This section provides an evaluation of how these predicted climate change impacts would affect the project alternatives, particularly with regard to potential flood scenarios.

GHG emissions resulting from the project alternatives were evaluated to determine how they may impact global climate change. The required data identified in the air quality section, such as construction equipment, truck trips, haul route data, construction worker information, and hours of operation, were used to quantify GHG emissions.

Wetland restoration may provide a buffer against climate change by capturing GHGs. This document explores the potential for the project to provide climate change benefits as compared to the existing condition and describes potential effects of climate change on the project. The project may also mitigate for releases of GHG. One of the most effective and inexpensive methods for removing carbon from the atmosphere remains the uptake and storage by natural ecosystems, and recent evidence suggests that coastal ecosystems are some of the most effective natural carbon "sinks." Coastal ecosystems, including salt marshes and seagrasses, are very productive ecosystems that remove carbon compounds from the air at very high rates (Duarte et al. 2010; Donato et al. 2011; McLeod et al. 2011; Fourqurean et al. 2012). This makes these ecosystems approximately equivalent to terrestrial forests in their ability to serve as carbon sinks, despite covering significantly less of the globe (McLeod et al. 2011). The carbon stored in coastal ecosystems is often referred to as "blue carbon."

GHG emissions and global climate change are governed by several federal and state laws and policies summarized below. Additional information is contained in Appendix C.

Executive Order 13653, *Preparing the United States for the Impacts of Climate Change*, directs federal agencies to pursue new strategies to improve the nation's preparedness and resilience to climate change.

Oregon House Bill 3543 establishes GHG emission reduction goals for Oregon and created the Oregon Global Warming Commission, which includes members that represent the social, environmental, cultural, and economic diversity of the state. The Oregon Global Warming Commission is required to recommend ways to coordinate state and local efforts to reduce GHG emissions in Oregon and prepare for the effects of climate change.

4.7.4.1 Methodology

This section summarizes the climate change impact analysis that was conducted and provides the action-related GHG emission results. The analysis was conducted following the general methodology described below.

This analysis estimates carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emissions that would occur during construction and demolition activities. The other pollutants commonly evaluated in various GHG reporting protocols – hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride – are not expected to be emitted in large quantities as a result of the action alternatives and are not discussed further in this section.

Each GHG contributes to climate change differently, as expressed by its global warming potential (GWP). GHG emissions are discussed in terms of CO_2 equivalent (CO_2e) emissions, which express, for a given mixture of GHG, the amount of CO_2 that would have the same GWP over a specific timescale. CO_2e is determined by multiplying the mass of each GHG by its GWP.

This analysis used the GWPs from the IPCC Fourth Assessment Report (Forster et al. 2007) for a 100-year time period to estimate CO_2e. This approach is consistent with the federal GHG Reporting Rule (40 CFR 98), as effective on January 1, 2014 (78 Federal Register [FR] 71904). The GWPs used in this analysis are 25 for CH_4 and 298 for N_2O.

Standard emission estimation models approved by the EPA were used to estimate emissions from construction activities associated with the action alternatives. The majority of the emissions would be from nonroad equipment used during construction activities. The emission factors for engine exhaust were used with estimated activity levels, such as number of pieces of equipment, number of days of active operation, and vehicle miles traveled, to determine total emissions of GHGs.

The construction activity emissions were estimated using the appropriate emission factor models and spreadsheet calculations. The following construction sources and activities were analyzed for emissions:

- Onsite construction equipment emissions with NONROAD2008a (EPA 2009)
- Offsite haul truck engine emissions with MOVES2014-20141021 (EPA 2014a)
- Offsite worker vehicle trips to and from the sites with MOVES2014-20141021 (EPA 2014a)

4.7.4.2.1 On-Road Mobile Sources

The equipment and activity specific emission factors are presented in **Table 4.7-5** for on-road vehicle travel. Emission factors were derived from the EPA's MOVES2014 (Version 20141021) emission factor model for Tillamook County, Oregon.

Table 4.7-5. On-Road Vehicle Emission Factors

Source	Emission Factors (grams per mile)		
	CO_2	CH_4	N_2O
Haul/Vendor Trucks	867	0.042	0.011
Construction Workers	376	0.016	0.012

Source: MOVES2014-20141021 (EPA 2014a)
Key:
CH_4 = methane
CO_2 = carbon dioxide
N_2O = nitrous oxide

It was assumed in the emission calculations that any exported material requiring disposal would be transported to Tillamook County Landfill located 10 miles from the project location. Additionally, it was assumed sand, gravel, and any other materials would be imported from vendors located within 20 miles of the project site. Because construction workers could reside in several cities surrounding the project site, the average commute distance for construction workers was also assumed to be 20 miles.

4.7.4.2.2 Nonroad Construction Sources

Table 4.7-6 presents the emission factors for nonroad construction equipment engines. The emission factors were developed for Tillamook County, Oregon, and it was assumed all equipment would be diesel-fueled.

Table 4.7-6. Nonroad Equipment Emission Factors

Equipment	Emission Factors (grams per hour)		
	CO_2	CH_4	N_2O
Excavators	54,692	3.11	1.39
Off-road Dump Trucks	247,874	14.08	6.31
Scrapers	129,526	7.36	3.30
Front End Loader	77,182	4.38	1.97
Sheepsfoot Vibratory Roller	30,425	1.73	0.77
Bulldozer	82,669	4.70	2.11

Source: MOVES2014-20141021 (EPA 2014a)
Key:
CH_4 = methane
CO_2 = carbon dioxide
N_2O = nitrous oxide

To estimate the nonroad equipment emissions, NONROAD2008a (EPA 2009) was run to generate County-specific daily emissions (tons per day) in 2015 for each equipment type listed in **Table 4.7-6**. The year 2015 was used to provide a conservative estimate because engine exhaust emissions generally decrease in future years as engine technology improves. Therefore, emission factors for the proposed construction schedule of 2016 and 2017 would be somewhat lower than the results for 2015 reported below.

The NONROAD Reporting Utility was then used to convert emissions to units of grams per hour for each equipment type. Assuming a 5-day per week construction schedule, construction equipment would operate an average of 22 days per month for 8 hours per day. The construction schedule provided by the project applicant was then used to estimate the number of hours each piece of equipment would operate during the project duration.

4.7.4.3 Affected Environment

Data generated from global circulation models are used to project changes to climate. Climate change projections are based on varying global circulation models and emissions scenarios documented in reports, as described below. Because each report is based on different models and scenarios, each has varying levels of uncertainty associated with the projected changes. For this analysis, the ranges of projected changes published in each report are presented. In addition, the models used for each report were conducted at different scales (regional, state, or local), as indicated in the descriptions below.

- **The United States Global Change Research Program (USGCRP)[5] climate impact analyses** (USGCRP 2009): The foundation for the USGCRP report is a set of 21 Synthesis and Assessment Products as well as other peer-reviewed scientific assessments, including those of the IPCC, the United States Climate Change Science Program, the United States National Assessment of the Consequences of Climate Variability and Change, the Arctic Climate Impact Assessment, the National Research Council's Transportation Research Board report on the Potential Impacts of Climate Change on United States Transportation, and a variety of regional climate impact assessments (USGCRP 2009). The scale of the USGCRP impact analysis results is for the Pacific Northwest.
- **Climate Change in the Tillamook Bay Watershed by the Oregon Climate Change Research Institute (OCCRI)** (OCCRI 2013): The *Climate Change in the Tillamook Bay Watershed* report describes the past climate of the Tillamook Bay Watershed, projects future climate change, and suggests possible impacts of climate change. The report focuses primarily on evaluating temperature, precipitation, and sea level.
- **The Oregon Climate Assessment Report** (OCCRI 2010): The Oregon Climate Assessment Report draws on research on climate change impacts in the western United States from the Climate Impacts Group at the University of Washington and the California Climate Action Team (OCCRI 2010). The scale of the OCCRI results is for the State of Oregon.

The projected changes in climate conditions are expected to result in a wide variety of effects in the Pacific Northwest[6] with regard to the alternatives. The most relevant consequences related to the alternatives include changes to temperature, precipitation, and sea level rise.

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[5] *United States Global Change Research Program is a consortium of 13 federal departments and agencies authorized by Congress in 1989 through the Global Change Research Act (Public Law 101-606). The USGCRP coordinates and integrates federal research on changes in the global environment and their implications for society.*

[6] *The Pacific Northwest is defined by the USGCRP as Washington, Oregon, Idaho, and western Montana.*

4.7.4.3.1 Increased Temperature

Future regional average annual air temperatures in Oregon are projected to increase by 0.2 to 1°F per decade, depending on future GHG emissions, as compared to temperatures in the 20th century (OCCRI 2010). Projected temperature increases for the Tillamook Bay watershed are presented in **Table 4.7-7**.

Baseline conditions for the Pacific Northwest are based on data from 1961 to 1979 (USGCRP 2009). Increased temperature may result in a variety of general consequences for the Pacific Northwest:

- Increased evaporation rates (USGCRP 2009)
- Increased incidence of wildfire (OCCRI 2010)
- Increased occurrence of short-term and long-term drought conditions (USGCRP 2009)
- Changes to soil moisture (USGCRP 2009), which may lead to soil subsidence under structures
- Buckling of pavement or concrete structures (USGCRP 2009)
- Decreased lifecycle of equipment or increased frequency of equipment failure (USGCRP 2009)
- Increased frequency of freeze-thaw cycles in winter months (USGCRP 2009)

Table 4.7-7. West Domain Projected Change in Mean Temperature (°F)

Period	2010-2039	2040-2069	2070-2099
Annual	1.7 to 2.0	3.2 to 4.3	4.2 to 7.2
Winter	1.7 to 2.0	3.1 to 4.0	4.1 to 6.7
Spring	1.6 to 1.8	2.8 to 3.7	3.7 to 6.1
Summer	1.8 to 2.3	3.7 to 5.0	4.8 to 8.3
Fall	1.6 to 1.9	3.1 to 4.5	4.2 to 7.6

Source: OCCRI 2013.
Note: Projections provided for the “west” domain of the watershed, which runs inland from the coastline to just beyond the City of Tillamook.

4.7.4.3.2 Annual Precipitation

The annual mean precipitation in the Tillamook Bay watershed is predicted to increase 5 percent by the year 2100 (OCCRI 2013). Although data from the climate models suggest a slight increase in the annual mean precipitation, there is a distinct difference in seasonality, with the spring and summer projected to be drier while the fall and winter would be wetter. **Table 4.7-8** summarizes the predicted change in precipitation in the Tillamook Bay Watershed.

Table 4.7-8. West Domain Projected Change in Precipitation (%)

Period	2010-2039	2040-2069	2070-2099
Annual	-1 to +1	+1 to +2	+3 to +5
Winter	+2 to +3	+5 to +6	+7 to +13
Spring	-5 to -3	-3 to -2	-4 to -3
Summer	-10 to -4	-20 to -14	-19 to -14
Fall	-1 to +3	+2 to +3	+5 to +6

Source: OCCRI 2013.
Note: Projections provided for the "west" domain of the watershed, which runs inland from the coastline to just beyond the City of Tillamook.

4.7.4.3.3 Reduced Snowpack

Reduced snowpack may result in a variety of general consequences for the Pacific Northwest, including increased incidence of short- and long-term drought and limited inundation periods for side channels, which serve as nurseries for young fish and other aquatic animals (Barr et al. 2010). Summer water supply also would decrease as a result of reduced snowpack (OCCRI 2010).

4.7.4.3.4 Increase in Heavy Precipitation

Projections show that by mid-century, heavy precipitation, defined as annual total precipitation divided by the number of "wet" days where precipitation exceeds one millimeter per day, would increase slightly in the Pacific Northwest (Federal Highway Administration [FHWA] 2010). The fraction of precipitation that falls on days where precipitation exceeds the 95th percentile was projected to decrease along the leeward side of the Cascade Mountains (Salathe et al. as cited in FHWA 2010). Diffenbaugh (2005) projected an increase of up to 10 extreme precipitation events per year in the Pacific Northwest (up to a 140 percent increase) under a higher emission scenario, with some variation depending on location within the region.

Increases in heavy precipitation may result in a variety of general consequences for the Pacific Northwest:

- Increased fine sediment in streams may result in negative effects on the spawning of native fish that build their nests in the areas of clean rocks and gravel (Barr et al. 2010).
- Increased frequency and severity of flooding may occur.
- Increased runoff may lead to surface water quality changes, including increased turbidity, increased organic content, color changes, and alkalinity changes.

4.7.4.3.5 Sea Level Rise

Sea level rise along the U.S. west coast is impacted by global sea level rise, as well as regional effects, including ocean and atmospheric circulation patterns (e.g., the El Niño-Southern Oscillation and the Pacific Decadal Oscillation), the effects of land ice mass changes, groundwater withdrawal or recharge, and tectonics along the coast (OCCRI 2013). **Table 4.7-9** summarizes the regional sea level rise projections relative to year 2000.

Table 4.7-9. Regional Sea Level Rise Projections (cm) Relative to Year 2000

Location	2030		2050		2100	
	Projection	Range	Projection	Range	Projection	Range
Newport[1]	6.8 ± 5.6	-3.5 to 22.5	17.2 ± 10.3	-2.1 to 48.1	63.3 ± 28.3	11.7 to 142.4

Source: OCCRI 2013.
Note:
1 - Data provided for Newport, Oregon, because it is the closest city to Tillamook with available data.
Key:
Projection = mean ± standard deviation for A1B model emissions; Range = means for B1 (low) and A1F1 (high) model emissions

4.7.4.4 Environmental Consequences

This section discusses the potential effects of the action alternatives and the No Action Alternative on GHG and of climate change on the alternatives. In December 2014, the Council on Environmental Quality (CEQ) released draft guidance for the consideration of GHG in federally proposed actions. The draft guidelines include a presumptive threshold of 25,000 metric tons of CO_2e emissions ($MTCO_{2e}$) from a proposed action to trigger a quantitative analysis. However, the document does not provide guidance on when to determine GHG emissions are “significant” for NEPA purposes but rather poses the question to the public (CEQ 2014). The EPA requires mandatory GHG reporting for any stationary combustion source that exceeds 25,000 $MTCO_2$e emissions, which supports using this threshold to determine significant adverse effects for GHG emissions.

Additionally, if a proposed design does not account for at least a 2-foot sea level rise, then a significant impact would occur.

4.7.4.4.1 No Action Alternative

Construction, Transition Period, and Long Term

Effects of the No Action Alternative on Climate Change

Under the No Action Alternative, the proposed flood damage reduction and ecosystem restoration actions would not be funded, and the project actions would not be implemented. As a result, there would be no construction activities, and GHG emissions would not occur. The No Action Alternative would have no impact on climate change.

Effects of Climate Change on the No Action Alternative

Because of the predicted increases in temperature, precipitation, and sea level rise, it is expected that increases in flooding would occur from the effects of climate change. Short-term effects (i.e., within the next 5 years) would be expected to be minor, local, adverse, and less than significant. Over the long-term, potential adverse effects due to climate change are expected to be moderate to major, regional, and significant.

4.7.4.4.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Effects of the Proposed Action on Climate Change

Construction

Under Alternative 1, sections of existing levees would be removed and modified, and new setback levees would be constructed as described in Section 3. GHG emission sources include exhaust emissions from off-road construction equipment, on-road haul trucks, and construction worker employee commuting vehicles. Detailed construction information, including the quantity and type of construction equipment, quantity of material imported or exported from the construction sites, total graded area, and the construction schedule were provided by the project applicant. **Table 4.7-10** summarizes predicted uncontrolled annual emission rates for CO_2e for the Proposed Action.

Table 4.7-10. Total Emissions by Source Type (Proposed Action)

Source	Project Emissions ($MTCO_2e$ per year)			
	CO_2	CH_4	N_2O	Total
Construction Equipment Exhaust	2,570	0.15	0.065	2,570
Haul/Vendor Truck Exhaust	102	0.0050	0.0013	102
Construction Worker Exhaust	27	0.0011	0.00085	27
Parking Lot Construction	9	0.013	0.069	9
Total	**2,707**	**0.17**	**0.14**	**2,708**

Key:
CH_4 = methane
CO_2 = carbon dioxide
$MTCO_2e$ = metric tons carbon dioxide equivalent
N_2O = nitrous oxide

GHG emissions would increase by 2,698 $MTCO_2e$ during construction, which is less than the significance threshold of 25,000 $MTCO_2e$. Although there would be a net increase in GHG emissions, the impact would be temporary, minor, regional, and less than significant, and mitigation would not be required.

Transition Period and Long Term

The proposed action will also allow for gains in additional climate mitigation benefits because of the considerable amounts of carbon stored in coastal habitats, including tidal marsh (Crooks et al. 2014). On average coastal marshes sequester 218 grams of carbon per square meter per year (g C m^{-2} yr^{-1}) (McLeod et al. 2011), which is approximately 2.4 tons of carbon per hectare per year (0.97 tons carbon per acre per year). Plant communities hopefully would attain these rates for sequestration within the first decade after restoration, if not sooner. For the Proposed Action, where 522 acres of marsh would be restored, this suggests that as much as 507.6 tons of carbon could be sequestered per year in the restored marsh area. This is equivalent to taking about 355 passenger cars off the roads permanently (EPA 2014b). When compared to the short-term emissions increases, the long-term effect would be expected to be a net sequestration of CO_2, providing a moderate, beneficial effect due to carbon capture in salt marsh biomass.

Effects of Climate Change on the Proposed Action

As described previously, climate change is predicted to affect the study area by increasing temperatures, precipitation, and sea level rise. The proposed changes in the levee configuration and restoration of the SFC project area are intended to reduce flood damages in portions of Tillamook, Oregon. As described in Section 3.4.2, the Proposed Action would reduce floods up to 1.5 feet in the study area, ranging from small, infrequent events through a 100-year event. As shown in **Table 4.7-9**, sea level could be expected to rise by 17.2 cm (0.56 feet) by 2050. Because the project has an expected design life of 40-50 years, there would be no adverse effects to the project from sea level rise. As a result, the improvements would be expected to assist the community in adapting to sea level rise that would occur from climate change. The Proposed

Action would provide minor, regional, short- and long-term beneficial effects against the impacts of climate change.

4.7.4.4.3 Alternative 2: Hall Slough Alternative

Effects of Alternative 2 on Climate Change

Construction

Under Alternative 2, sections of existing levees would be modified, new setback levees would be constructed, and Hall Slough would be widened and deepened as described in Section 3. Construction details (e.g., type and quantity of construction equipment) and the construction schedule were estimated based on information provided by the project applicant. Because the amount of levee work would be approximately half of that required for the Proposed Action, the construction schedule for Alternative 2 was assumed to be half of the duration of the Proposed Action. **Table 4.7-11** summarizes the predicted annual emissions associated with construction activities that would occur during implementation of Alternative 2.

Table 4.7-11. Total Emissions by Source Type (Alternative 2)

Source	Project Emissions ($MTCO_2e$ per year)			
	CO_2	CH_4	N_2O	Total
Construction Equipment Exhaust	1,243	0.071	0.032	1,243
Haul/Vendor Truck Exhaust	47	0.0023	0.00061	47
Construction Worker Exhaust	13	0.00053	0.00040	13
Total	**1,303**	**0.073**	**0.033**	**1,303**

Key:
CH_4 = methane
CO_2 = carbon dioxide
$MTCO_2e$ = metric tons carbon dioxide equivalent
N_2O = nitrous oxide

As shown in **Table 4.7-11**, GHG emissions would be less than those estimated for the Proposed Action (see **Table 4.7-10**) and would be less than the significance threshold of 25,000 $MTCO_2e$. Adverse impacts related to GHG pollutant emissions from implementation of Alternative 2 would be minor, regional, and less than significant, and mitigation would not be required.

Transition Period and Long Term

The Hall Slough Alternative would require periodic maintenance dredging of the channel, which would cause an increase in GHG emissions from marine vessels, generators, employee commuting, and other sources. Although these emissions were not quantified, increased emissions from operational activities would be minimal because of the limited duration of any dredging activities.

The Hall Slough alternative would also allow for gains in additional climate mitigation benefits through carbon sequestration. For this alternative, where 90 acres of wetland would be restored, this suggests as much as 88 tons of carbon could be sequestered per year in the restored marsh area. Over the long term, carbon sequestration from the project could be expected to offset CO_2 produced during construction, providing minor, regional, beneficial effects due to carbon capture in marsh biomass.

Effects of Climate Change on Alternative 2

As described previously, climate change is predicted to affect the study area by increasing temperatures, precipitation, and sea level rise. The proposed improvements to Hall Slough and the setback levees are intended to reduce flood damage in portions of Tillamook, Oregon. Because the project would be designed to accommodate at least 2 feet of sea level rise and have a design life of 40-50 years, there would be no adverse effects to the project from sea level rise. As a result, the improvements would be expected to assist the community in adapting to sea level rise that would occur from climate change. The Hall Slough Alternative would provide minor, regional, short- and long-term beneficial effects against the impacts of climate change.

4.7.4.4.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Effects of Alternative 3 on Climate Change

Construction

Under Alternative 3, sections of existing levees would be removed, and new setback levees would be constructed as described in Section 3. Construction details (e.g., type and quantity of construction equipment) and the construction schedule were estimated based on information provided by the project applicant. Because the amount of levee work would be approximately equal to the Proposed Action, the construction schedule for Alternative 3 was assumed to be equal to that provided for the Proposed Action. **Table 4.7-12** summarizes the predicted annual emissions associated with construction activities that would occur during implementation of Alternative 3.

As shown in **Table 4.7-12**, GHG emissions would be less than those assumed for the Proposed Action (see **Table 4.7-10**) and would be less than the significance threshold of 25,000 $MTCO_2e$. Adverse impacts related to GHG emissions from implementation of Alternative 3 would be minor, regional, and less than significant, and mitigation would not be required.

Table 4.7-12. Total Emissions by Source Type (Alternative 3)

Source	Project Emissions ($MTCO_2e$ per year)			
	CO_2	CH_4	N_2O	Total
Construction Equipment Exhaust	2,570	0.15	0.065	2,570
Haul/Vendor Truck Exhaust	99	0.0048	0.0013	99
Construction Worker Exhaust	27	0.0011	0.00085	27
Parking Lot Construction	9	0.013	0.069	9
Total	**2,705**	**0.16**	**0.14**	**2,705**

Key:
CH_4 = methane
CO_2 = carbon dioxide
$MTCO_2e$ = metric tons carbon dioxide equivalent
N_2O = nitrous oxide

Transition Period and Long Term

This alternative would also allow for gains in additional climate mitigation benefits through carbon sequestration. Under Alternative 3, where 568 acres of marsh would be restored, this suggests that as much as 553 tons of carbon could be sequestered per year in the restored marsh area. This is equivalent to taking about 387 passenger cars off the roads permanently (EPA 2014b). When compared to the short-term emissions increases, the long-term effect would be expected to be a net sequestration of CO_2, providing a moderate, regional, beneficial effect due to carbon capture in salt marsh biomass.

Effects of Climate Change on Alternative 3

As described previously, climate change is predicted to affect the study area by increasing temperatures, precipitation, and sea level rise. The proposed changes in the levee configuration and restoration of the SFC project area are intended to reduce flood damage in portions of Tillamook, Oregon. Because the project would be designed to accommodate at least 2 feet of sea level rise and have a design life of 40-50 years, there would be no adverse effects to the project from sea level rise. As a result, the improvements would be expected to assist the community in adapting to sea level rise that would occur from climate change. Alternative 3 would provide minor, regional, short- and long-term beneficial effects against the impacts of climate change.

4.7.5 Hazardous Materials

Hazardous materials may occur in soil, groundwater, surface water, and sediments from historical or current land uses. Hazardous materials may include herbicides, pesticides, petroleum products, solvents, or other metals and chemicals that can pose hazards to people or the environment. While lands within the project area primarily have been used for agriculture, some properties have past and current commercial or industrial use where there is a potential for localized release of hazardous materials.

This section describes the potential for encountering hazardous materials during construction based on existing information from environmental sampling and a search of regulatory databases for properties within the project area. The potential impacts related to short-term exposure of construction workers and the public to contaminated soil, sediment, surface water, and/or groundwater from historic releases if contaminated media is handled, transported, or disposed are discussed. Other potential impacts may include the potential for accidental release of construction-related hazardous materials or the mobilization of harmful materials from areas that previously have been protected from tidal inundation.

The transport and disposal of hazardous materials is regulated at the federal and state levels by EPA and ODEQ, respectively. In Oregon, ODEQ is tasked with enforcing Environmental Cleanup Laws for the protection of the state's environmental resources. ODEQ's Land Quality program is responsible for waste reduction and management, spill preparedness and response, environmental assessment and cleanup, and underground storage tank compliance and cleanup. ODEQ maintains a state-wide database that provides information on sites with the potential for hazardous materials.

Within Tillamook County, the County Public Works Department, Division of Emergency Management, and the County fire department are responsible for responding to accidental releases of hazardous materials.

4.7.5.1 Methodology

The evaluation of impacts related to hazardous materials considered the potential to encounter contaminated soil and/or groundwater at properties where such contamination has been identified. Available databases and local studies were reviewed for information about known sources of contamination, and the status of remediation efforts was used as an indicator of potential risk.

4.7.5.3 Affected Environment

Much of the study area was historically used as grazing lands or for growing hay and is currently still in those uses. Hazardous materials typically associated with agricultural use include herbicides and pesticides. However, since agriculture in the Tillamook Valley has emphasized dairy production for many decades, the use of herbicides or pesticides is generally minor and limited to spot treatments. In addition, chemical fertilizers are not generally used as fields are fertilized with manure. Within the SFC project area, the hayfields have been managed as an organic operation for many years.

There are a small number of parcels within and near the study area where past land uses have entailed the use, generation, or storage of hazardous materials. Environmental Data Resources (EDR) conducted a search of regulatory databases, including federal, state, and local environmental records, to identify sites within the project area where hazardous materials may be present based on regulatory records of investigation and/or remediation conducted under the oversight of federal, state, or local agencies (EDR 2014).

The database search results were evaluated for sites located where removal or modification of levees or other earth-moving activities would be conducted under the proposed alternatives. Facilities that handle hazardous materials but have not necessarily had a release to the environment do not represent a potential concern for the project alternatives and were not considered further. In addition, sites were not further considered if cleanup and/or investigation was completed and the regulatory agency determined no further action was required.

Sites where there is potential for encountering hazardous materials in soils or groundwater during construction of the project alternatives due to previous or current land uses are listed in **Table 4.7-13** and shown on **Figure 4.7-10**. Although site grading and excavation would not occur outside of the study area boundaries, it is important to consider contaminated sites adjacent to proposed work zones as well as within the study area because contaminated materials may migrate through soils or groundwater and impact an area larger than the source property.

Table 4.7-13. Properties with Potential for Hazardous Materials

Site Name	Address/Intersection	Status
Sadri Property	Northwest of Front and Douglas St. along Hoquarten Slough	To be purchased by County of Tillamook. Phase I/II ESA conducted (AGI 2013, 2014a). Findings indicate the presence of contaminants in shallow soil and groundwater. Further investigation was conducted, including a risk evaluation (AGI 2014b). Concentrations of petroleum hydrocarbons and polycyclic aromatic hydrocarbons and metals in soils exceed risk-based screening levels in some areas.
Schmidt Property	Near Front and Douglas St.	Owned by City of Tillamook. Phase I/II ESA conducted. Further action may be needed to address soil contamination (EDR 2014).

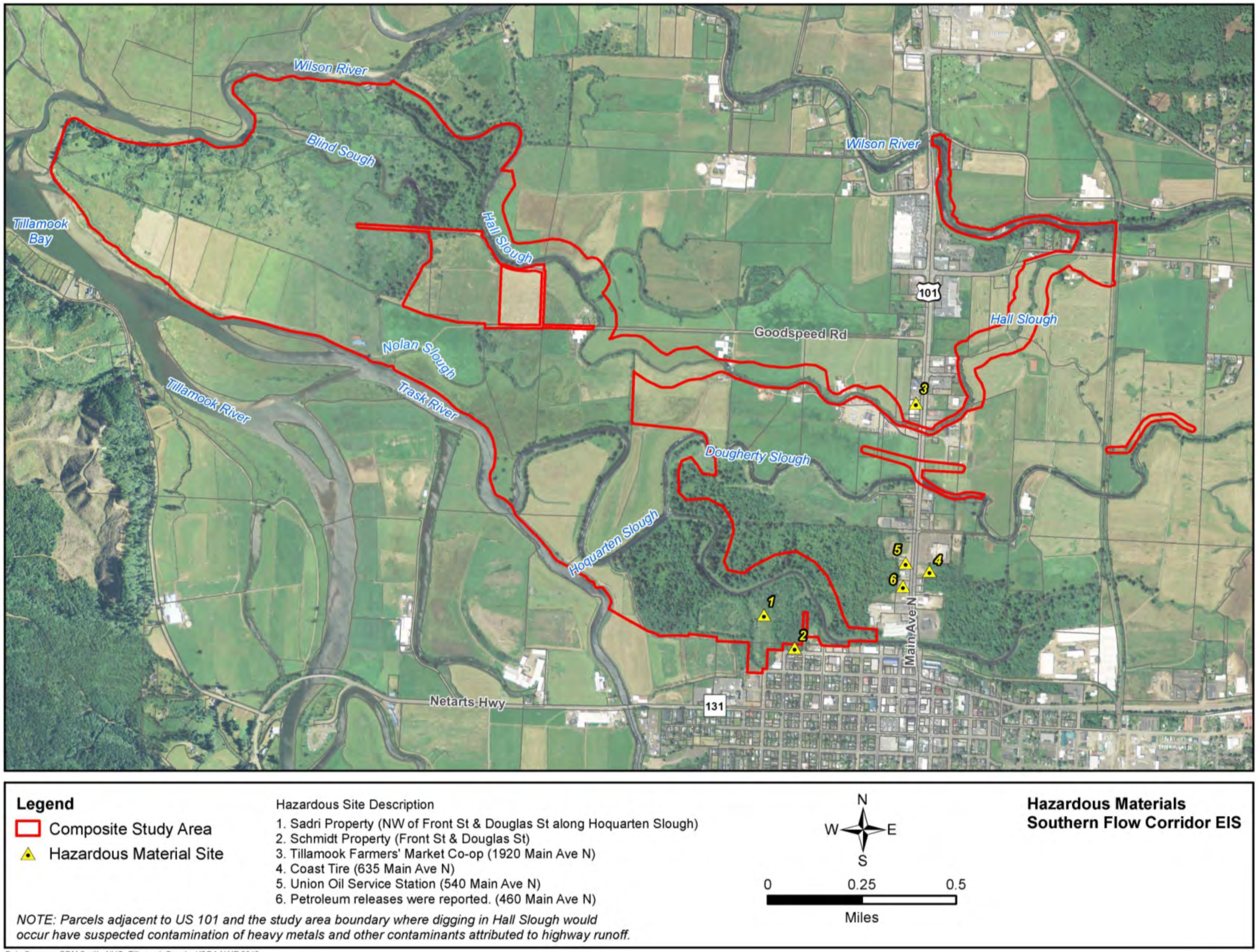
Site Name	Address/Intersection	Status
Tillamook Farmers' Co-op	1920 Main Ave. N.	Feasibility Study recommended by ODEQ, November 2003 (EDR 2014).
Coast Tire	635 Main Ave. N.	ODEQ issued a no further action; however, contamination remains in site soil and groundwater, requiring notification prior to disturbance for development (EDR 2014). Purchased by City of Tillamook with a deed restriction.
Union Oil Service Station	540 N. Main	ODEQ issued a no further action; however, contamination remains in site soil and groundwater, requiring notification prior to disturbance for development (EDR 2014).
N/A	460 N. Main	Vicinity petroleum releases reported (EDR 2014). Localized contamination may remain in soil or groundwater.

Contaminants at the Sadri property (location #1 on **Figure 4.7-10**) consist of heavy oil, metals, and polynuclear aromatic hydrocarbons in the shallow soils around the two former mill sites. These contaminants are believed to have originated from releases of wastes associated with the mill operations, including equipment lubrication, general machining, and sharpening of cutting and log peeling equipment. The contaminants on the three narrow parcels to the east of the Sadri property within the project area, owned by the City, appear to be related to contaminants that were present in the fill material that was placed in the area over the last 40 years (AGI 2014b).

No other concerns related to hazardous materials were identified. Based on historical uses of the project area, there are no sources of heavy metals or other contaminants that would be mobilized in the environment or pose a threat to human health or the ecosystem.

While tidal restoration in other areas has been shown to increase the accumulation of mercury in the local aquatic food web, the potential for MeHg formation following restoration of tidal marsh in the Tillamook estuary under the project alternatives is low. Restoration of farmland back to tidal wetlands in areas with elevated mercury levels in the soil has been shown to increase the accumulation of mercury in the local aquatic food web (see Technical Memorandum in Appendix F). These elevated levels may be a result of mining in the watershed or use of chemicals on the farmland.

Based on data from previous investigations, the concentrations of total mercury in Tillamook Bay sediments are typical of those found in other basins that have not been impacted by mining or other mercury sources. In addition, mercury concentrations in Tillamook Bay sediments are lower than those found in other parts of the Oregon Coast Range. Therefore, restoration of tidal wetlands in the Tillamook estuary would not be expected to result in formation of MeHg that could cause adverse effects in the aquatic environment or risks to public health.



Data Sources: CDM Smith, NHC, Tillamook County, USDA NAIP 2012

Figure 4.7-10. Properties with Potential for Hazardous Materials in Soil or Groundwater near the Study Area

4.7.5.4 Environmental Consequences

This section describes the potential impacts related to hazardous materials from construction and long-term maintenance of the project alternatives. Impacts related to hazardous materials were evaluated for each of the project alternatives. Impacts would be significant if construction activity in and around known contaminated properties would result in risks to the public or ecological receptors from the release of contaminants at concentrations greater than established regulatory levels or if construction-related hazardous materials, such as fuels and oils, were released to the environment.

4.7.5.4.1 No Action Alternative

Construction

Under the No Action Alternative, there would be no construction and therefore no potential to encounter hazardous materials in soil and/or groundwater in the study area. There would be no construction-related hazardous materials usage, storage, or transport, and no potential for impacts to human health or the environment from the accidental release of hazardous materials.

Transition Period and Long Term

Under the No Action Alternative, the Sadri property would not be cleaned up, and the contaminated materials would not be disposed of or contained. Therefore, there would remain a moderate, local, long-term risk of contaminated materials from the site being picked up by floodwaters and moving into area waterways where they could impact aquatic life. There would be no direct impacts associated with hazardous materials from the No Action Alternative, but there could be continued moderate adverse and significant impacts from the identified contamination on the Sadri property.

4.7.5.4.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Impacts Related to Contaminated Soil and Groundwater

Construction

During construction, there is a potential to encounter contaminated soil and/or groundwater at or near several of the properties listed in **Table 4.7-13**. Contaminant levels at the Sadri property may present a risk of exposure to construction workers and appropriate precautions would be employed during cleanup activities. Potential contaminant levels are unknown at the other locations noted in the table. Excavation activities at any known site could result in potential exposure of construction workers to unacceptable levels of contaminants through dermal exposure and inhalation of contaminants during soil removal. Release of hazardous materials could also result in exposure to the public or sensitive receptors. The Tillamook Regional Medical Center is adjacent to the Sadri property and would be considered a sensitive receptor. Exposure could occur through the release of dust or vapors from exposed soil and/or groundwater.

Contaminants in soil and groundwater may also result in impacts to ecological receptors (terrestrial and aquatic wildlife) if there is erosion of contaminated soils to surface waters, such as Hoquarten Slough or Hall Slough, or if there is residual contamination left in soil excavation areas such as at the Sadri property. Removal or modification of levees could also allow contaminants in groundwater to migrate to surface waters by exposing soil currently saturated by shallow contaminated groundwater to surface water flows.

In addition, construction could involve the transport of soil or other media contaminated with hazardous materials to a disposal facility located away from the project area. As such, there is potential for adverse effects from the accidental release of these hazardous materials during transport.

Soils at the Sadri property were classified into three types for the purposes of the Proposed Action based on the level of contamination. The goal would be to re-use as much of this material as fill, either on site or off site, minimizing the need for costly trucking and disposal of the material to a Subtitle D landfill; the nearest one is in Hillsboro, Oregon, located 65 miles east of Tillamook. Type 1 soils are those in which no contaminants have been detected, or they are present below ecological screening levels and ODEQ clean fill criteria. Type 1 soils can be used as fill throughout the project area and likely would be re-used in new levee construction to fill ditches or raise subsided areas. Type 2 soils are those that have organic contaminants above ecological screening levels but below clean fill criteria. Type 2 soils may be suitable for re-use as fill within upland areas but with controls such as a cap. Alternatively, these soils may be disposed at a Subtitle D landfill. Type 3 soils are those with organic contaminants above ecological screening levels and clean fill criteria. Metals are also present above natural background concentrations in these soils. As with Type 2, these soils may be used in upland areas with proper controls or may be disposed at a Subtitle D landfill.

Type 2 and Type 3 soils together total 20,800 cubic yards, including up to 600 cubic yards that would require landfilling due to the presence of free product (heavy oil) (AGI 2014b). Therefore, most of the material would be suitable for re-use as fill in upland areas on site with additional controls, such as an impermeable liner or cap, to further limit erosion and migration of contaminants into sensitive ecological environments and to limit human exposure to the contaminated material. (A significant portion of the Type 2 soils is large pieces of concrete that may be reclassified as Type 1 soils if it meets ODEQ criteria for clean fill.) Contaminated Type 2 and 3 soils are proposed to be consolidated and placed at the south side of the Sadri property in a containment cell. This area would be capped and used as a parking lot with a hiking trail and/or a public day-use area. This area is approximately 90,000 square feet and would be raised approximately 3.4 feet in elevation with the placement of all of the Type 3 soils. Consolidation and capping would prevent future exposure to contaminated materials by the public and the environment.

The cleanup of the Sadri property would be conducted by the County under ODEQ's voluntary cleanup program. The cleanup would be funded with state and local funds only. Since onsite areas would still be within the floodplain but outside of wetlands, alternative disposal options are also described in the 8-step decision-making process in Appendix D.

In addition, a Contaminated Media Management Plan (CMMP) would be implemented during construction within areas of known or suspected contamination, including the Sadri property. The CMMP would describe the proposed measures for protection of human health and the environment during soil excavation and placement for disposal. In addition, if material is left on site, the site preparation, construction, and capping of the areas where contaminated soil would be contained on site would be engineered such that the mobility of contaminants in the fill material is controlled.

Potential worker exposure to contaminants during construction would be evaluated by comparing contaminant concentrations in the shallow soils against ODEQ risk-based concentrations for construction and excavation workers. A health and safety plan would be implemented prior to the start of construction to establish procedures to be followed if contamination is encountered. This would include required training prior to the start of work, personal protective equipment, and emergency procedures.

To avoid or reduce impacts to ecological receptors from residual contaminants in soils at the Sadri property, the concentrations of contaminants in the resulting “leave” surface (i.e., the exposed, residual soils left on the finished ground surface following construction) must not exceed screening levels for ecological receptors. Sediment screening values for the contaminants of concern at the Sadri property have been established by the NOAA Restoration Center for protection of aquatic organisms. Some areas may require some over-excavation above what is required to construct the Proposed Action to meet these screening levels. This would be detailed in the CMMP.

Adverse impacts related to hazardous materials would be moderate and local during construction at the Sadri property. Compliance with federal, state, and local laws and regulations regarding hazardous materials would be required during construction to avoid or reduce potential impacts. Impacts related to hazardous materials would be minor and less than significant with implementation of mitigation measures and compliance with applicable regulations.

Transition Period and Long Term

Cleanup of hazardous materials on the Sadri property would result in beneficial long-term effects.

During routine maintenance of levees and floodgates in the transition period and long term, there would be the potential for the release of hazardous materials related to the use of construction equipment similar to that described for the construction period. Adverse impacts would be minor, local, and less than significant. BMPs related to the use of construction equipment and the handling of fuels and lubricants would be applied to ensure potential impacts would be negligible to minor.

Accidental Release of Hazardous Materials from Construction Equipment

Adverse effects may occur from the accidental release of construction-related materials, such as fuels and oils, used for construction equipment operating near surface waters during construction and during long-term maintenance of levees and other structures associated with the Proposed Action. Proposed design criteria established in PROJECTS (NMFS 2013a) would be applicable to the Proposed Action for protection of aquatic life. These include general construction measures for preventing the release of contaminants to surface waters. These BMPs are described in Section 6.

4.7.5.4.3 Alternative 2: Hall Slough Alternative

Construction

Based on the EDR report, there is low potential to encounter contaminated soil and/or groundwater during construction of Alternative 2. There would be no development at the Sadri property under Alternative 2. Of the areas of concern identified in **Table 4.7-13** and shown on

Figure 4.7-10, the Tillamook Farmers' Co-op, located at 1920 N. Main Avenue, is the closest property to where construction would occur for Alternative 2.

While there would be a concern about contaminated soils adjacent to major roadways, such as Highway 101, construction for Alternative 2 would not include levee setback activities at the Highway 101 crossing.

The Hall Slough Alternative would involve dredging and widening of Hall Slough. Based on historical dredging of channels in and near the study area, it is assumed sediments in Hall Slough would be below ecological screening levels and meet ODEQ clean fill criteria. Therefore, there would be no effect from contaminated sediments under the Hall Slough Alternative.

A CMMP would be implemented during construction to outline the measures for protection of human health and the environment during soil excavation. In addition, a health and safety plan would be implemented prior to the start of construction to establish procedures to be followed if contamination is encountered. This would include required training prior to the start of work, personal protective equipment, and emergency procedures.

As with Alternative 1, there is potential for release of construction-related hazardous materials during construction. In addition, the Hall Slough Alternative likely would involve the use of barge-mounted equipment to conduct dredging operations or would require construction equipment to enter the water from the sides. Working with construction equipment in or over water increases the risk of an accidental spill of hazardous materials. BMPs would be implemented to prevent the accidental release of hazardous materials and/or wastes used or generated during construction as described in Section 6.

Adverse impacts related to hazardous materials would be minor and local during construction. Impacts would be less than significant. Compliance with federal, state, and local laws and regulations regarding hazardous materials would be required during construction to avoid or reduce impacts.

Transition Period and Long Term

Transition-period and long-term effects would include the potential for accidental release from the use of construction equipment during levee and floodgate maintenance activities. The Hall Slough Alternative would require periodic maintenance dredging of the channel, which would include increased risk of accidental spills from equipment used over or in the water. Adverse impacts would be minor, local, and would be less than significant. BMPs related to the use of construction equipment and the handling of fuels and lubricants would be applied during maintenance actions to ensure potential impacts would be negligible to minor.

Under Alternative 2, the Sadri property would not be cleaned up, and the contaminated materials would not be disposed of or contained. Therefore, there would remain a moderate long-term risk of contaminated materials from the site being picked up by floodwaters and moving into area waterways where they could impact aquatic life.

4.7.5.4.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction

The potential for encountering contaminated soil and/or groundwater during construction of Alternative 3 would be similar to that described for Alternative 1. Under Alternative 3, the contaminated material at the Sadri property would be cleaned up as described under Alternative 1. A CMMP would be implemented during construction within these areas to outline the measures for protection of human health and the environment during soil excavation. In addition, a health and safety plan would be implemented prior to the start of construction to establish procedures to be followed if contamination is encountered. This would include required training prior to the start of work, personal protective equipment, and emergency procedures.

Like the other action alternatives, there is a potential for release of construction-related hazardous materials during construction. BMPs as described in Section 6 would be implemented to prevent the accidental release of hazardous materials and/or wastes used or generated during construction.

Adverse impacts related to hazardous materials would be moderate and local during construction at the Sadri property. Compliance with federal, state, and local laws and regulations regarding hazardous materials would be required during construction to avoid or reduce potential impacts. Impacts related to hazardous materials would be minor and less than significant with implementation of mitigation measures and compliance with applicable regulations.

Transition Period and Long Term

Cleanup of hazardous materials on the Sadri property would result in beneficial long-term effects.

In the transition period and long term, Alternative 3 would have minor, local, adverse impacts from hazardous materials that would be less than significant. During routine maintenance of levees and floodgates, there would be the potential for the release of hazardous materials related to the use of construction equipment similar to that described for the construction period. BMPs related to the use of construction equipment and the handling of fuels and lubricants would be applied to ensure potential impacts would be negligible to minor.

4.7.6 Visual Quality and Aesthetics

An important component of the Tillamook Valley economy is tourism and recreation dependent on the natural scenic values of the Oregon Coast. This section considers the aesthetics and visual resources of the project area and evaluates potential short- and long-term changes to the scenic qualities of the landscape based on the exiting visual resources, public sensitivity towards the landscape, and the visibility of the landscape from travel routes or observation points in the project area.

4.7.6.1 Methodology

This aesthetic and visual resource assessment is based on the visual resource inventory methodology found in *Visual Impact Assessment for Highway Projects*, FHWA-HI-88-504 (FHWA 1988). This methodology is commonly used for a variety of project types and is similar to those used by the United States Forest Service and Bureau of Land Management.

This assessment is also based on a review of maps, site photographs, and information gathered during site visits. The evaluation of the potential impacts on visual resources from implementing the action alternatives is based on an analysis of the extent and implications of potential visual changes, considering the following factors:

- Specific changes in the visual composition, character, and specifically valued qualities of the affected environment
- Visual context of the affected environment
- Extent to which the affected environment contained places or features that have been designated in plans and policies for protection or special consideration
- Number of viewers, their activities, and the extent to which these activities are related to the aesthetic qualities affected by the program- and project-related changes

4.7.6.2 Affected Environment

This section provides an overview of the existing aesthetic resources in the project area based on the following concepts and terminology for the protection and evaluation of aesthetic resources. Overall, visual quality is analyzed qualitatively using the following terms:

- **Vividness** – describes the presence of distinctive landscape features, such as topographic relief, geological formations, color, or patterns, that combine to form a striking or memorable visual pattern.
- **Intactness –** describes the integrity of a landscape and the degree to which it is free from incongruous or out-of-place features that detract from the visual pattern.
- **Unity –** describes the appearance of the landscape as a whole and the degree to which the visual elements maintain a coherent visual pattern.

The proposed project area is situated within the floodplains and lower reaches of the Wilson, Trask, and Tillamook rivers. Visual resources in the study area consist of dairy pasturelands in the near view and forested foothills that surround the City of Tillamook in the extended view. Elevations in Tillamook County vary from near sea level in the coastal lowlands to above 3,500 feet in the Coast Range Mountains.

Many visitors to the vicinity of the study area drive through the City of Tillamook toward the coast on 3rd Street/OR 131 and then return using the same route. Looking toward the study area, visitors traveling west would view open fields and pasturelands in a rural residential setting and when returning see those same areas with patches of hardwood/riparian forest visible near the Sadri property to the northeast. Travelers on Bayocean Road towards Cape Meares get the clearest view of the SFC study area as they approach Memaloose Point. People using the boat launch at Memaloose Point, looking toward the SFC study area, currently have a view of tide flats, the levee embankment, and open lands beyond.

The rivers and streams adjacent to the project area are part of a National Recreational Water trail and are included in a series of guidebooks prepared by the Tillamook Estuary Partnership for the Tillamook Water Trails system. These are used regularly by canoers, kayakers, and other paddle boat enthusiasts. Boaters floating at water level on the Trask or Wilson rivers mostly would have a view of the levee embankments. Traveling north or south on Highway 101 within the study area, views consist of small businesses located along the highway. Beyond these businesses, and in areas where the highway crosses rivers and sloughs, open fields and patches of hardwood/riparian forest are visible. In the study area, scenic views of the estuary and ocean shoreline are obscured by the Coast Range Mountains or foreground vegetation.

Given the predominance of the current agricultural land uses in the areas surrounding the study areas, current viewer groups include farmworkers on site as extended viewers and visitors and local residents utilizing OR 131, Bayocean Road, and Highway 101 as transient viewers.

For transient viewers on OR 131 and Highway 101, the background view of the Coast Range Mountains creates a unified visual pattern with consistent colors and texture produced by the evergreen forests. When traveling west, transient viewers on OR 131 would observe open fields and pasturelands with interspersed riparian vegetation in and around drainages and waterbodies in the near view. Colors and textures would be similar to the background view in spring and early summer, and a shift to warmer brown colors in late summer to fall would generate some visual contrast. When returning, these viewers would see the same open fields and pasturelands along with the patches of hardwood/riparian forest as they approached the City of Tillamook. This view is broken by farm support structures in some locations that introduce sharp vertical and horizontal lines to the otherwise natural background. However, these structures are not visually distracting, given their infrequent occurrence and the short visual duration for transient viewers. Similar to the transient viewers, extended viewers in the project area would observe near view features consistent in color and texture to the background view, with the exception of views from areas immediately adjacent to farm support structures where visual contrast is more severe but not inconsistent with views that would be anticipated in an agricultural area.

Long views for travelers along Bayocean Road are largely obscured by the hills that rise steeply from the road on the west and foreground vegetation. There are occasional openings where a view opens out over the Trask River or the bay. Extended viewers along Bayocean Road are likely to be residents or persons using the boat launch at Memaloose Point or persons in boats on the waters around the study area.

Transient and extended viewers in the Hall Slough study area likely would be accessing the area along Wilson River Loop. Views in this area are primarily of dairy farms with the Coast Range mountains in the background. Views of Hall Slough itself are largely obscured by foreground vegetation, riparian vegetation along the slough, and levee embankments.

Figure 4.7-11, **Figure 4.7-12**, and **Figure 4.7-13** provide some representative views of the study area. While these photos were taken within the SFC study area, they are representative of many typical views throughout the study area.

4.7.6.3 Environmental Consequences

An assessment of aesthetic resource quality is subjective, and reasonable disagreement can occur as to whether alterations in the visual character of a project area would be adverse or beneficial. For this analysis, a conservative approach was taken, and the potential for major change to the visual character of an area is generally considered a significant impact.

Figure 4.7-11. View of Wilson River, Tide Flat, Levee Embankment with Coast Range Background

Figure 4.7-12. View of Agricultural Fields, Trees Along Slough in Distance with Coast Range Background

Figure 4.7-13. View of Dairy Cows with Trees Along Slough in Distance and Coast Range Background

For the purpose of this analysis, a major change is any permanent alteration that results in introduction of a new view feature that presents a distracting contrast to the existing viewshed in color, texture, or line. An example of this type of change would be removal of trees that screened the view of a structure or structures in an area with rural character and little visible development. The severity of these types of changes also would be expected to vary amongst viewers; for example, local viewers accustomed to the lack of structures in the viewshed would be more substantially impacted than occasional viewers (e.g., tourists) who may not notice the changed view.

4.7.6.3.1 No Action Alternative

Construction, Transition Period, and Long Term

Under the No Action Alternative, there would be no construction in the study area, existing levee configurations would remain the same, and there would be no change in flood elevations. In the absence of a flood, the No Action Alternative would have no effect on visual quality and aesthetics. Under the No Action Alternative, it is possible a flood could generate major local impacts to visual quality and aesthetics in the study area in the short term with damage to farm structures, roads, and trees in the near views that would be significant. These impacts would be reduced over time as vegetation reestablishes.

Over time, the current agricultural activities would be phased out on the County-owned land in the SFC project area, which would likely result in a transition from hayfields to freshwater wetlands. This change would result in no effect on the visual character of the study area.

4.7.6.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Construction and Transition Period

During construction of Alternative 1, there would be temporary effects on visual quality and aesthetics in areas where levees would be removed or modified. Construction equipment and materials would be visible to visitors and residents in some areas. Construction work would be most visible to people at the west end of Goodspeed Road, those along Bayocean Road, and in the southeast corner of the project area near the east end of Front Street. Construction work would be largely obscured from the view of boaters by the levee embankments until the latter portion of the construction work when it would become highly visible. Construction equipment would create a major contrast, and areas of disturbed soil would be present, as illustrated in **Figure 4.7-14**. Once the construction is completed, areas of disturbed soil would be present, but as vegetation becomes reestablished, the visual contrast with surrounding marsh lands would diminish.

Photograph by Roy Lowe, USFWS

Figure 4.7-14. Visual Effects of Construction Equipment and Disturbed Soils

In areas where green pasturelands are the predominant viewscape for much of the year, such as along OR 131 to the west of the City of Tillamook and along Bayocean Road, disturbed soil and construction vehicles likely would be highly visible, but temporary, alterations during construction. The removal of trees along levees will be visible in the distance from these locations. These impacts likely would be major changes for most transient and extended viewers of the project area in the short term during construction and during the transition period as vegetation reestablishes and would be significant.

Potential impacts for recreational visitors in the project area, including bird watchers and kayakers, would be similar to those described for transient viewers. These impacts would be considered significant in the short term and during the transition period, given the potential for prolonged views of construction activities and disturbed earth prior to the reestablishment of vegetation during the transition period.

The visual impact of tree removal could be moderate and significant in the short term and transition periods for transient viewers who regularly travel these routes, as there would be a change in the effect of trees marking the location of the sloughs. Infrequent visitors to the area may find this change less significant, given a likely more limited recollection of these trees.

Long Term

There would be minor, local, long-term, adverse effects on landscape type or character of the project area as tidal marsh vegetation would resemble the current hayfields and pasture lands. Impacts would be less than significant.

Tree removal that would occur in the project area would be a long-term permanent effect but would result in minor to moderate changes to the character of the viewscape, given the existence of other intermittent trees in the near views as well as well-established forestland in the background view. Impacts would be less than significant. Transient viewers traveling east towards the City and along Highway 101 could have brief glimpses of portions of the project area where trees would be removed.

Options to mitigate these significant impacts are limited, given the need to remove levees and fill areas that are providing suitable growing conditions for trees to accomplish the necessary improvements in flood protection. It is expected the proposed changes in tidal influence and ground elevations would result in a permanent change in the vegetation in the project area to one that is more historically accurate and consistent with other less altered lands around the bay. However, this may still result in a significant visual impact for some viewers.

4.7.6.3.3 Alternative 2: Hall Slough Alternative

Construction and Transition Period

During construction of Alternative 2, there would be temporary effects on visual quality and aesthetics in areas where levees would be removed or modified. Reaches where the slough would be widened and deepened would be unlikely to be visible from the major roads, particularly as the work would be below the level of the surrounding ground elevation. However, construction equipment, including support vehicles, on site in the short term would be visible from local roads and residential and commercial units adjacent to the project area. Although the project area crosses Highway 101, little work would be conducted close to the highway, as the bridge would not be altered and levee alteration would be screened by structures along the highway. Construction equipment would also be visible to transient viewers along Wilson River Loop, Goodspeed Road, and from places along Highway 101. These short-term alterations in visual quality and aesthetics would be less significant in the short term than under Alternative 1 because the work would be located in closer proximity to commercial and agricultural structures and operations where large equipment is a more common sight. The Hall Slough Alternative would result in the removal of all of the riparian vegetation and trees along Hall Slough. Unlike the trees in the SFC study area, the vegetation along Hall Slough is predominantly deciduous and generally shorter in stature; however, the view of trees in the distance across open agricultural fields would be lost in the short term and for a transition period while vegetation becomes reestablished. This potential effect is likely to be moderate to major for extended viewers and minor to moderate for transient viewers and could be significant for some viewers.

Similar to Alternative 1, options to mitigate the short-term and transition-period impacts of vegetation removal and earth disturbance are limited by the time required for vegetation reestablishment.

Long Term

There would be minor, local, long-term, adverse effects on landscape type or character of the project area as tidal marsh vegetation would resemble the current hayfields and pasture lands. Impacts would be less than significant.

4.7.6.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction and Transition Period

The Alternative 3 project area is very similar to the Alternative 1 project area, and the types of modifications to be implemented on site, while somewhat different in configuration, are similar in type and impact. The short-term introduction of construction equipment across the project area and the removal of trees along the levees would result in major changes for many transient and extended viewers. Similar to Alternative 1, these impacts would be reduced quickly to a minor impact for transient viewers during the transition period while vegetation is reestablished.

Long Term

There would be minor, local, long-term, adverse effects on landscape type or character of the project area as tidal marsh vegetation would resemble the current hayfields and pasture lands. Impacts would be less than significant. As with Alternative 1, there may be a small population of long-term viewers and potential residents for whom the loss of views of trees along the levees in the distance is an irreversible major and significant impact.

Similar to Alternative 1, options to mitigate the significant impacts are limited, given the need to remove levees and fill areas that are providing suitable growing conditions for trees to accomplish the necessary improvements in flood protection. It is expected the proposed changes in tidal influence and ground elevations will result in a permanent change in the vegetation in the project area to one that is more historically accurate and consistent with other less altered lands around the bay. However, this may still result in a significant visual impact for some viewers.

4.8 Cultural Resources

This section describes the cultural resources associated with the project area and potential effects on cultural resources of each of the alternatives.

Several federal and state laws and regulations provide for protection of cultural resources, including historic and archaeological resources and Native American cultural and religious sites. These laws are described in more detail in Appendix C and Appendix I. The National Historic Preservation Act (NHPA), Section 106 (54 U.S.C. 300101, et seq.) requires federal agencies to determine whether a project has the potential to affect historic resources and identify potentially affected historic resources. If a project has the potential to affect historic resources, there are additional requirements to consult with the state historic preservation officer and tribes and to seek input from the public. The process for compliance with Section 106 is detailed in 36 CFR Part 800.

Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, sets forth guidelines for all federal agencies to (1) establish regular and meaningful consultation and collaboration with Indian tribal officials in the development of federal policies that have tribal implications, (2) strengthen the United States government-to-government relationships with Indian tribes, and (3) reduce the imposition of unfunded mandates upon Indian tribes.

The State of Oregon also protects archaeological resources through the Indian Graves and Protected Objects regulations (ORS 97.740-760) and the Archaeological Objects and Sites regulations (ORS 358.905-961; ORS 390.235). The state has policies and permit requirements related to cultural resources surveys and coordination with the Oregon State Historic Preservation Office (SHPO).

4.8.1 Methodology

The cultural resources evaluation included the following steps: tribal coordination, background research and a literature review, field reconnaissance and survey, technical report preparation, and evaluation of the effects of the alternatives. Consultation with SHPO and tribes was conducted by FEMA and is described in Section 7. The methodology for gathering data on existing cultural resources that may occur in the project area is described in the Cultural Resources Investigations Technical Memorandum in Appendix I.

Background research on the study area (which is the area of potential effect [APE]) and potential historic properties within the APE was conducted to gather information on the historic context. This research included personal interviews with long-time residents of the area and contractors who had worked in the area in the past, as well as online sources, historic maps and aerials, and previous reports.

A pedestrian survey of the project area was conducted in July 2014 to photograph and record any potential historic properties and structures. A field survey for archaeological resources was conducted in August 2014 using shovel test units to document the presence or absence of archaeological sites and isolates within the area of potential effect. In addition, the County engaged qualified archaeologists to conduct archaeological monitoring of the geotechnical test pits on the Sadri property in September 2014, and those results were evaluated for this EIS.

4.8.2 Affected Environment

The coastal lowlands at the edge of Tillamook Bay historically supported wetlands and streams rich in fish, wildlife, and important plant materials. The SFC study area (APE) would have had very wet estuarine conditions for many centuries, and it is expected the study area (APE) has a low probablity of containing cultural resources from Native American use and occupation.

As described by Ames and Maschner (1999), modern climatic conditions were in place by 2000 B.P. Native American lifeways seen at the time of European and American contact were fully in place by the beginning of the Late Pacific period. These included settlement in permanent winter villages and a variety of field camps used seasonally to obtain and process resources as they became available. The study area (APE) is part of the traditional territory of the Nehalem

Tillamook who spoke the Nehalem dialect of the Coast Salish language group. Their territory extended from Nehalem on the north to the Siletz River on the south.

The history of Euro-American settlement of Tillamook begins in the 1850s, when Joseph C. Champion arrived in 1851. Within the next few years, two families and several bachelors followed (Marschner 2008). Most of the settlers were farmers, and they began small subsistence farms, usually near the bay or one of the five rivers that drain into the bay. However, because the growing season was short, rainy, and cool, most crops the settlers planted did not fare well. Many turned to dairy farming for which the area seemed well-suited (Marschner 2008). By 1900, there were 631 farms in the area (Siegel 1994).

The study area (APE) is a flat, low-lying floodplain separated by natural meandering sloughs, and a network of levees and ditches were constructed as flood control devices and to facilitate settlement and agriculture. The levees are typically linear, and most are approximately 20 feet wide by 8 to 12 feet above surrounding waterways. Levees were constructed with dredged river sediments, local soils, and imported gravel and rock.

As cities, such as San Francisco and Portland, entered a period of rapid growth, timber and lumber mill industries were quickly established to fill the need for wood products used in urban and maritime construction. By 1894, "the timber industry was considered Tillamook County's most important industry" (E&S Environmental Chemistry, Inc. 2003). Lumber mills became a common feature across this part of Oregon, and by 1923, 20 such mills were operating in Tillamook County (E&S Environmental Chemistry, Inc. 2003).

Two former lumber mill and veneer factories are located at the northwest margin of the City of Tillamook, near the intersection of Front Street and Douglas and Cedar streets. Tillamook Spruce Veneer Company began operations sometime around 1926 on the southwest side of Hoquarten Slough (Levesque 1985). After 8 years in business, the owners of the Tillamook Spruce Veneer mill moved the operation to Coos County, abandoning the mill's buildings and log ponds. The property sat vacant until 1944 when the Aberdeen Plywood Company constructed a new mill west of the old Tillamook Spruce Veneer site and demolished the old Tillamook Spruce Veneer structures (Levesque 1985). After the mill closed in the mid-1960s, the log ponds were drained, and fill material was deposited on the southeast corner of the west log pond (AGI 2013, 2014a, 2014b). This property is now known as the Sadri property and is discussed further below.

Background research on the study area (APE) indicates that no pre-contact or historical sites are recorded within the APE, and with a few small exceptions, the area has not been subject to archaeological investigations. The survey of potential historic properties in the project area (APE) was limited to those that were built in or before 1969 (45 years from 2014). This survey identified two dwellings, including one with multiple outbuildings, a series of manmade drainage ditches with multiple culverts and tide gates and a collection of manmade levees along the rivers and sloughs.

Concurrent with the cultural resource survey for this project, Tillamook County contracted for an archaeological monitor to monitor the geotechnical investigations at the Sadri property and the City parcels to the east of Sadri in September 2014. The soil and sediment sampling was conducted as part of an environmental remediation investigation project. The goal of the monitoring was to identify, document, and protect any cultural resources exposed during soil testing. The monitor visually inspected excavation sidewalls and spoils for the presence of cultural materials (SWCA Environmental Consultants 2014). Historical debris and foundation elements consistent with the construction and operation of the Tillamook Spruce Veneer Company mill and the Aberdeen Plywood Company mill were identified by both the SWCA monitors and by the survey conducted for this EIS.

The cultural resources survey identified one historic era archaeological site associated with veneer and plywood mills and one historic era archaeological isolate (an abandoned horse drawn farm implement). Four built environment sites were recorded, including two residential structures and two sites related to the extensive levee and ditch systems across the study area (APE). These resources are recommended as not-eligible for listing in the National Register of Historic Places (NRHP).

These buildings, structures, sites, and isolate were surveyed, and their eligibility for listing in the NRHP was evaluated based on the Secretary of Interior's Standards. Based on the evaluation, none of the built environment in the project area is eligible for the NRHP. In keeping with the guidance provided in *Oregon Parks and Recreation Department Guidance for* Recording *and Evaluating Linear Cultural Resources* (Oregon SHPO 2013), the systems of levees and ditches within the study area (APE) were evaluated as possible historic districts because they are interconnected systems of linear features.

Although the systems of levees and ditches within the study area (APE) are associated with the development of the area, they no longer retain sufficient integrity of materials, design, feeling, workmanship, and in some cases, association (see Appendix I for more detail on each resource).

While the former mills located on the Sadri property became a complex of structures over time, the site does not qualify either as an industrial archaeological district or as a resource eligible for listing in the NRHP. No evidence has been found to suggest either facility was unique in construction, function, or technology. Additionally, the buildings surveyed within the study area (APE) were determined to not retain sufficient integrity. These resources are recommended as not eligible for listing in the NRHP and are discussed further in the Cultural Resource Technical Report (Appendix I).

4.8.3 Environmental Consequences

This section describes the potential impacts related to cultural resources from construction and long-term maintenance of the project alternatives. The potential for impacts on cultural materials to occur was evaluated for each of the project alternatives. If resources eligible for listing in the NRHP would be adversely affected, then FEMA would coordinate with interested parties to resolve the potential impacts. If impacts could not be avoided or resolved, then there would be a significant impact on cultural resources.

4.8.3.1 No Action Alternative

Construction, Transition Period, and Long Term

Because there would be no construction under the No Action Alternative, there would be no potential for impacts related to cultural resources. Under the No Action Alternative, there would be no change in the existing levee and drainage system or the built environment in the study area (APE); therefore, there would be no impact on cultural resources.

4.8.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Construction

During construction of the Proposed Action, it is highly unlikely any part of the former lumber mills at the Sadri property would yield information concerning the history of the mills themselves or of Tillamook in general beyond what has already been documented in the historic record. All available and pertinent information regarding the mills was collected during the survey and the exhaustive literature, cartographic, and photographic reviews. The location and physical remains of these mills are recommended as not eligible for listing on the NRHP. No further archival or archaeological work is recommended for the former Tillamook Spruce Veneer Company's mill and the Aberdeen Plywood Company's mill (FEMA 2014b).

Although the project area likely was utilized for a variety of resource procurement activities by pre-contact populations, it was in general found to be largely unsuitable for archaeological sites of the type that are most likely to be discovered with archaeological surveys. The SFC study area (APE) would have had very wet estuarine conditions for many centuries, and it is expected the study area (APE) has a low probability of containing cultural resources from Native American use and occupation. Field surveys found almost the entire study area (APE) subject to seasonal or tidal inundation with no significantly higher ground that might have provided more suitable locations for the prolonged or repeated uses that are now reflected as archaeological sites. No National Register eligible historic properties were identified or recorded during cultural resources surveys (Appendix I). The Proposed Action would have little potential to discover archaeological resources although it would include a significant amount of earthwork, and a determination of "no historic properties affected" was made by FEMA. The implementation of mitigation described below would ensure impacts to cultural resources would be less than significant.

Transition Period and Long Term

Transition-period and long-term maintenance would consist of maintenance of the new and modified levees and occasional replacement of floodgate structures. Since all of these activities would occur in the disturbed levee materials, there would be no potential to impact cultural resources through activities associated with the transition-period and long-term implementation of the Proposed Action.

Mitigation

Although considered unlikely based on the field surveys, literature reviews, and other cultural resources evaluations, there is a potential for inadvertent discovery of and impacts to cultural resources associated with the mill sites at the Sadri property during construction of the Proposed Action (SWCA Environmental Consultants 2014).

An inadvertent discovery plan (IDP) would be implemented to avoid or reduce potential impacts to cultural resources during construction. The purpose of the IDP is to assist project proponents in complying with Oregon statutes in the event archaeological objects or sites are inadvertently discovered during site development and related ground disturbance. An IDP for archaeological objects and sites is different from an IDP for human remains, cairns, burials, funerary objects, sacred objects, and objects of cultural patrimony of any native Indian (per ORS 97.740–760).

The IDP assumes the project proponent will have an Oregon "qualified" professional archaeologist (per ORS 390.235) and staff (as needed) on site during development-related ground-disturbing activities during the cleanup activities at the mill sites on the Sadri parcel. The IDP includes the following components.

1. If archaeological objects are encountered, construction will be stopped by the archaeological monitor at the location of the find and the following measures will be implemented:
    - An Oregon "qualified" professional archaeologist will assess the find in terms of its NRHP eligibility (significance) through documentation (e.g., photographs, description, GPS point collection, notation, sketch map, profile, screening spoil materials). If deemed necessary, exploratory excavations (test units) will be excavated in the immediate vicinity to determine if a larger site is present.
    - Oregon SHPO and tribal contacts will be informed of any encountered archaeological objects.
    - If after assessment and documentation the find is not considered potentially eligible for the NRHP, construction may continue.
    - If after assessment and documentation the find is considered potentially eligible for NRHP listing, the Oregon SHPO and tribes will be contacted and notified of the find, and a plan to proceed will be developed.
    - Mechanical excavations will not be stopped by the archaeological monitor if a single artifact, such as a single lithic flake, brick fragment, or glass shard, is identified.
2. If an archaeological site is encountered, construction will be stopped by the archaeological monitor at the location of the find, and the following measures will be implemented:
    - The Oregon SHPO state archaeologist or assistant state archaeologist will be contacted as well as the appropriate tribes.
    - Through consultation, a plan to address the find will be developed.

4.8.3.3 Alternative 2: Hall Slough Alternative

Construction

As with the Proposed Action, there is a low potential for inadvertent discovery of and impacts to cultural resources during construction. However, the Hall Slough Alternative would not include any work at the Sadri parcel.

The cultural resources survey did not extend into the upper ends of the Hall Slough project area because it is outside of the APE for the Proposed Action. However, the alternative is designed to avoid impacts to structures. Therefore, there would be no adverse effect on the built environment. In addition, the literature review and background research included information from the larger context of the APE, which does include the Hall Slough project area, and there was no indication of potential for cultural resources.

Construction of the alternative would involve setting back levees and widening and deepening the slough. Levee setback activities would be unlikely to affect archaeological resources because the existing levees are constructed of fill materials largely derived from alluvial sediments dredged from the slough. The widening and deepening work similarly would be unlikely to impact archaeological resources, as the extent of the work is minimal and likely would remain within alluvial deposits. Therefore, the Hall Slough Alternative would have no effect on historic properties. Despite the low probability for impacts, this alternative likely would require an archaeological monitor to be on site during the channel modification work unless further site investigations indicate a monitor would not be necessary.

Transition Period and Long Term

Transition-period and long-term maintenance of the Hall Slough Alternative would include levee maintenance and periodic dredging of the slough to maintain the design configuration. Maintenance work would be conducted entirely in previously disturbed areas, and there would be no potential to impact cultural resources through activities associated with the transition-period and long-term implementation of the Hall Slough Alternative.

Mitigation

An IDP as described under the Proposed Action would be implemented during construction to ensure impacts to cultural resources are less than significant. Because the Hall Slough Alternative does not include work at the Sadri parcel, a monitor would not be required at that location.

4.8.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction

As described for the Proposed Action, there would be no effect on known cultural resources, and there is a low potential for inadvertent discovery of and impacts to cultural resources during construction. The Initial Alternative project area includes fewer historic resources than the Proposed Action because the Jones House and farm buildings are excluded from the project area. While the Initial Alternative project area is somewhat larger than the Proposed Action area, the additional area is pasture land with historic and current characteristics similar to much of the area that was surveyed for the Proposed Action. Similar to the Proposed Action, Alternative 3 would have no effect on historic properties.

Transition Period and Long Term

There also would be no effect on cultural resources during transtion-period and long-term maintenance activities.

Mitigation

An IDP would be implemented during construction to ensure impacts to cultural resources are less than significant as described under the Proposed Action.

4.9 Socioeconomics

These sections will provide an overview of the socioeconomic environment and the potential impacts from each of the alternatives on these resources, including the regional economy, environmental justice, and public health and safety.

4.9.1 Economics

This section describes the regional economy, including the agricultural industry, and analyzes potential effects on the regional economy that could result from implementing the proposed alternatives.

There are no federal regulations or authorities related to regional economics. State and local plans have policies in place to protect and develop regional economies.

Oregon has developed Statewide Planning Goals and Guidelines for use in development of comprehensive plans by counties, cities, and other local jurisdictions. Goal 9 is for Economic Development: To provide adequate opportunities throughout the state for a variety of economic activities vital to the health, welfare, and prosperity of Oregon's citizens (Oregon Department of Land Conservation and Development 2010). Tillamook County and the City of Tillamook have developed comprehensive plans consistent with these state goals (Tillamook County 2011; City of Tillamook 2012). The City of Tillamook’s 2012 Comprehensive Plan goal for economic development is to diversify and improve the local economy with the following objectives:

- Objective 1: To improve the economic vitality of the Tillamook area and revitalize the Tillamook City downtown
- Objective 2: To create more and better jobs in Tillamook, raise per capita income, and have the resulting wealth be retained and reinvested in the community so as to create a better quality of life for all (City of Tillamook 2012)

4.9.1.1 Methodology

Economic effects are evaluated qualitatively, using existing quantitative data where available. A regional economic effects analysis considers the changes in local economic activity as a result of a project or action. Effects are evaluated in factors such as employment, income, economic output, and other economic parameters. Total effects include direct, indirect, and induced effects. Indirect and induced effects are the result of “multiplier effects” and account for changes in business activity of support industries and changes in household income as a result of a direct effect. Indirect economic effects also can occur as a result of environmental impacts.

4.9.1.2 Affected Environment

The population of Tillamook County was 25,300 at the last census. Incorporated cities in the County include Bay City (population 1,371), Garibaldi (population 736), Manzanita (population 421), Nehalem (population 270), Rockaway Beach (population 1,130), Tillamook (population 4,949), and Wheeler (population 366) (U.S. Census Bureau 2014. Traditional industries in Tillamook County include agriculture (principally dairy), lumber/forestry, fishing, and recreation/tourism. The City of Tillamook is the closest city to the project area and could be directly affected by any changes in flooding. Both the County and the City would be affected by changes in the productivity of fisheries (including shellfisheries) in the bay or by effects that impact recreation.

4.9.1.2.1 Economic Characteristics

Employment is an important economic indicator to evaluate the magnitude of potential economic effects. **Table 4.9-1** shows occupations and employment in Tillamook County, the City of Tillamook, and the state. Tillamook County has higher percentages of service; natural resources, construction, and maintenance; and production, transportation, and material moving occupations than the state as a whole. This is largely because of the agricultural and tourism industries in Tillamook County. The Tillamook Creamery is a major component of the region's economy, employs a substantial number of workers, and also attracts visitors to the region (EcoNorthwest 2013).

Table 4.9-1. Occupations in Tillamook County 2009-2013 5-Year Estimate

Occupation	Oregon		Tillamook County		City of Tillamook	
	Estimate	Percent	Estimate	Percent	Estimate	Percent
Civilian employed population 16 years and over	1,736,894		10,374		2,063	
Management, business, science, and arts occupations	634,691	36.50	2,807	27.10	493	23.90
Service occupations	318,427	18.30	2,015	19.40	426	20.60
Sales and office occupations	419,680	24.20	2,398	23.10	423	20.50
Natural resources, construction, and maintenance occupations	157,860	9.10	1,452	14.00	283	13.70
Production, transportation, and material moving occupations	206,236	11.90	1,702	16.40	438	21.20

Source: U.S. Census Bureau 2014, 2009-2013 American Community Survey 5-Year Estimates

Table 4.9-2 shows industry employment for Tillamook County, the City of Tillamook, and the state. Educational services, health care, and social assistance employed the most people in Tillamook County, followed by arts, entertainment, and recreation and accommodation and food services.

Table 4.9-2. Industry Employment in Tillamook County 2009-2013 5-Year Estimate

Industry	Oregon		Tillamook County		City of Tillamook	
	Estimate	Percent	Estimate	Percent	Estimate	Percent
Civilian employed population 16 years and over	1,736,894		10,374		2,063	
Agriculture, forestry, fishing and hunting, and mining	60,577	3.50	1,041	10.00	75	3.60
Construction	97,305	5.60	807	7.80	142	6.90
Manufacturing	194,442	11.20	1,079	10.40	336	16.30
Wholesale trade	51,796	3.00	155	1.50	11	0.50
Retail trade	211,085	12.20	1,287	12.40	259	12.60

Industry	Oregon		Tillamook County		City of Tillamook	
	Estimate	Percent	Estimate	Percent	Estimate	Percent
Transportation and warehousing and utilities	73,203	4.20	684	6.60	170	8.20
Information	33,237	1.90	68	0.70	5	0.20
Finance and insurance; and real estate, rental and leasing	103,472	6.00	528	5.10	92	4.50
Professional, scientific, and management and administrative and waste management services	180,788	10.40	559	5.40	78	3.80
Educational services and health care and social assistance	396,275	22.80	1,778	17.10	396	19.20
Arts, entertainment, and recreation and accommodation and food services	167,898	9.70	1,309	12.60	258	12.50
Other services, except public administration	87,552	5.00	409	3.90	69	3.30
Public administration	79,264	4.60	670	6.50	172	8.30

Source: U.S. Census Bureau 2014, 2009-2013 American Community Survey 5-Year Estimates

The Port of Tillamook Bay is about 2 miles south of the City of Tillamook and consists of over 1,600 acres of land zoned for industrial use, of which approximately 400 acres have been designated as a National Register Historic District (POTB 2014). The district and the multiple National Register designated buildings within the district are an important tourist draw to the Tillamook area. The Port includes a Category IV airport (more than 2,500 annual operations or more than 10 based aircraft) with a primary and secondary runway. POTB also owns extensive rail rights of way. The POTB rail line is 101 miles in length, of which roughly 88 miles are main line and the other 13 miles are spurs and sidings. POTB leases a 3.5-mile section from Banks to Hillsboro to PNWR (Portland Northern & Western Railroad). In addition to right-of-way ownership, POTB rail assets include locomotives, steel rail, and embedded ties. The Industrial Park comprises 785 acres and has a variety of sites and buildings available for occupancy. Lastly, POTB owns a recreational vehicle (RV) park with 52 campsites with picnic tables, spaces for self-contained RVs, as well as drinking water and restrooms (POTB 2009).

4.9.1.2.2 Property

According to its Comprehensive Plan, Tillamook County has 713,600 acres of land generally divided among forestland (92 percent or 656,512 acres), agricultural (5 percent or 35,680 acres), and other land (3 percent or 21,408 acres). About 66 percent of the land is in public ownership (federal, state, and local), 22 percent in private corporate ownership (commercial forests), and 12 percent in other private ownership (Tillamook County 1982). The government and commercial forest lands do not change hands very often; therefore, these percentages are likely still a good indicator of the relative proportion of various ownership categories.

The City of Tillamook had 2,389 housing units, of which 1,335 were single detached units. Owners occupied 805 units, and renters occupied 1,171 units. The median value of owner-occupied homes was $168,700 (U.S. Census Bureau 2014).

4.9.1.2.3 Recreation

Section 4.9.4 describes the recreation setting in the study area and evaluates potential effects of the action alternatives on recreation. Changes in recreation can result in economic impacts because visitors spend money in the regional economy and support recreation-related industries or businesses such as hotels, restaurants, parks, and other tourist-related attractions. A report on Oregon Coast tourism estimated $1.6 billion was spent on overnight trips along the Oregon Coast in 2013. Average per person expenditures on overnight trips were estimated to be $49 on lodging, $31 on restaurant food and beverage, $20 on retail purchases, $13 on transportation at destination, and $13 on recreation/sightseeing/entertainment (Longwoods Travel USA 2013). About 67 percent of visitors were from Oregon, 18 percent from Washington, 5 percent from California, and 2 percent from Idaho (Longwoods Travel USA 2013).

Tillamook Bay offers recreational fishing for Chinook salmon, hatchery produced coho salmon, steelhead, sturgeon, crab, and shellfish. Anglers that come to Tillamook Bay for fishing spend money in the region and support the regional economy. **Table 4.9-10** in Section 4.9.4 shows salmon angler trips in the Tillamook catch area. In 2012, there were 12,387 recreational salmon angler trips, and in 2013, there were 14,904 recreational salmon angler trips to the Tillamook catch area. The Pacific Fishery Management Council Review of 2013 Ocean Salmon Fisheries estimated community and state personal income impacts of the troll and recreation ocean salmon fishery in the Tillamook port area were $503,000 in 2012 and $620,000 in 2013.

Crabbing is another important recreational activity that contributes to the regional economy. **Table 4.9-12** in Section 4.9.4 shows estimated monthly crabbing trips in Tillamook Bay from 2008 through 2011. The most recreational crabbing trips in Tillamook Bay occurred in 2009, with an estimated 7,465 trips. In 2011, there were an estimated 5,637 trips. About half of the recreational crabbers in Tillamook Bay interviewed in an ODFW survey traveled less than 50 miles, but over 11 percent traveled over 150 miles. Almost 85 percent of all crabbers were Oregon residents, and nearly 10 percent traveled from Washington. Most crabbers in Tillamook Bay traveled from the northern Willamette Valley area or were local residents from the North Oregon Coast (ODFW 2012).

Tillamook Bay also has a popular clam bed for recreational clam digging. A bay clam recreational fishery survey in Tillamook Bay estimated the total number of clam digging trips per year during a 5-year sample (Ainsworth et al. 2014). The number of trips ranged from just over 6,000 in 2010 and 2011 to over 11,000 in 2012. Most of the clam diggers interviewed had dug clams at Garibaldi Flat. Clam diggers were most successful at Garibaldi Flat and Bayocean where the total clams per digger was almost 20 (the daily bag limit) in every year of the survey.

ODFW completed the *Fishing, Hunting, Wildlife Viewing, and Shellfishing in Oregon 2008 State and County Expenditure Estimates* in 2009 (ODFW 2009). **Table 4.9-3** presents estimated travel-generated expenditures and local recreation expenditures in Tillamook County for 2008.

Table 4.9-3. Recreation Expenditures in Tillamook County in 2008 ($1,000s)

Activity	Travel-Generated	Local Recreation
Shellfishing	7,689	992
Fishing	34,710	2,080
Hunting	2,477	541
Wildlife Viewing	18,569	1,607
Combined Activities	63,446	5,221

Source: ODFW 2009

4.9.1.2.4 Commercial Fishing

Tillamook Bay also has commercial fishing opportunities. The commercial salmon fishing season starts in May and ends December 31, with a peak in the fall. The ex-vessel value for salmon for the state was $4.1 million in 2012, with an annual average of $1.8 million from 2007 to 2011. **Table 4.9-4** shows the numbers of days fished and Chinook and coho landings from 2008 to 2013.

Table 4.9-4. Number of Days Fished and Landings in Tillamook Catch Area

Year	Days Fished	Chinook Landings	Coho Landings
2008	49	76	-
2009	271	144	3,491
2010	400	3,648	-
2011	220	1,106	-
2012	632	7,399	-
2013	852	9,165	-

Source: Pacific Fishery Management Council 2014

The commercial crab season starts December 1 and closes August 15 although some season openings are delayed if the crabs are not sufficiently filled out with meat. The commercial ocean crab fishery for Oregon is currently restricted to 427 permitted vessels, each with a specific pot limit. Over the last 10 years, approximately 300 to 350 vessels have been active in the ocean commercial crab fishery, with seasonal landings between 12 and 33 million pounds and an ex-vessel value worth $25 to 50 million per year (ODFW 2012). In 2012, the ex-vessel value for Dungeness crab was $42.2 million (ODFW 2013).

4.9.1.2.5 Agricultural Economy

Table 4.9-5 presents data on the number and size of farms and type of commodities produced in Tillamook County. In 2012, Tillamook County had 280 farms encompassing 36,551 acres. The primary commodity is cattle and calves. Crops grown in the County are hay and corn for silage and very limited vegetable acreage.

Table 4.9-5. Number and Size of Farms and Agricultural Commodities in Tillamook County in 2012

Farm Statistics and Commodities	Tillamook County
Number of Farms	280
Land in Farms (acres)	36,551
Average Size of Farms (acres)	131
Total Cropland (acres)	14,482
Harvested Cropland (acres)	11,389
Cattle and Calves Inventory (number)	45,063
Forage-land used for all hay and haylage, grass silage, and greenchop (acres)	10,567
Corn for Silage (acres)	1,386
Vegetables Harvested (acres)	39

Source: United States Department of Agriculture (USDA) 2014. 2012 Census of Agriculture

Table 4.9-6 shows data on market values, income, and expenses for agriculture in Tillamook County. Livestock contributed the most to the market value of agricultural projects sold.

Table 4.9-6. Agricultural Economy Data for Tillamook County in 2012

Agricultural Economic Parameter	Tillamook County
Market Value of Agricultural Products Sold (1,000$)	117,141
Average per farm ($)	418,361
Crops (including nursery and greenhouse) (1,000$)	3,037
Livestock, Poultry, and Their Products (1,000$)	114,104
Total Farm Production Expenses (1,000$)	103,919
Average per farm ($)	371,141
Net Cash Farm Income of Operation (1,000$)	22,017
Average per farm ($)	77,631
Estimated Market Value of all Land and Buildings (average $ per farm)	817,065
Estimated Market Value of all Machinery and Equipment (average $ per farm)	115,752

Source: USDA 2014. 2012 Census of Agriculture

4.9.1.3 Environmental Consequences

This section discusses the potential effects of the action alternatives and the No Action Alternative on the regional economy.

An alternative would have a significant adverse impact on the regional economy if it results in long-term substantial losses in output and employment relative to the existing output and employment in the regional economy. Regional economies are typically defined at the county level. Some of the alternatives would have beneficial effects, which would be positive for the regional economy by increasing output or employment.

4.9.1.3.1 No Action Alternative

Construction

There would be no construction-related effects on the regional economy.

Long Term

Under the No Action Alternative, the land previously purchased by the County for wetland restoration would not be restored, levees would not be removed, and tidal wetlands with the expected ecological benefits would not occur. This means the existing conditions with respect to fish and wildlife recreation and commercial harvests would not change.

Approximately 152 acres of land currently in agricultural production within the study area are owned by Tillamook County with conditions that require the cessation of agricultural uses (other County land in the study area is not currently in production). Therefore, under the No Action Alternative, it is assumed the existing agricultural leases would be allowed to lapse over time and use as pasture or hay production would cease even though tidal wetlands would not be restored. The effect of this loss of agricultural production could adversely affect the agricultural economy by decreasing farm revenues, reducing employment for farm workers, and decreasing sales of agricultural-support businesses. In 2012, Tillamook County had over 35,000 acres in farms (USDA 2014). Therefore, the acreage of currently farmed land expected to be taken out of production under the No Action Alternative would be less than 1 percent of the agricultural land in the County. This minor conversion of acreage of agricultural land would result in a negligible adverse economic effect. In addition, the 392 acres previously purchased for open space are no longer contributing to County property tax revenues; however, this would be a negligible effect.

In the absence of a flood, the No Action Alternative would have no effect on the regional economy, including the agriculture and recreation/tourism industries. Under the No Action Alternative, it is possible a flood could result in significant impacts to the regional economy. The Tillamook region has experienced floods in the past, and damages to residences, businesses, and agricultural enterprises have been substantial.

In general, physical flood damage can include building losses, such as damage to the structure itself, as well as damage to components, such as lighting, ceilings, mechanical and electrical equipment, and other fixtures; building content losses, such as furniture, equipment that is not integral with the structure, computers, and other supplies; and building inventory losses dependent on the production of a particular business in the building, such as retail or high tech manufacturing.

Since 1977, 62 residential flood insurance claims have been paid out in Tillamook County for a total of $1,978,146, which averages out to be $31,905.58 per claim paid (including both structure and contents), and does not represent costs associated with displacement or loss of rental income from rental property (NHC 2012). Based on claims data filed for the December 28, 1998 flood event, there were seven claims filed for a total of $374,066. The average claim paid for that 1998 flood event was $45,215. Based on claims data for the November 6, 2006 flood event, there were 18 residential flood insurance claims paid for a total of $708,846. This averages $43,960 per claim.

Since 1977, 155 commercial property flood insurance claims have been paid in the amount of $6,033,398, which averages $38,925 per claim paid (NHC 2012). Based on claims data filed for the December 28, 1998 flood event, there were 23 claims filed for a total of $1,176,731. The average claim paid for that 1998 flood event was $74,535. Based on claims data for the November 6, 2006 flood event, there were 21 commercial flood insurance claims paid for a total of $1,769,332. This averages $92,125 per claim (NHC 2012).

Flood damage could also affect the recreation/tourism industry of Tillamook County. Visitors could be deterred from coming to the region as the County recovers from flood damages. This would result in fewer dollars being spent at hotels, restaurants, Creamery tours, boat charters, and other businesses that support recreation.

Floods also result in agricultural losses. Tillamook County's primary agricultural commodities are related to the dairy industry, including production of livestock, pasture, and hay. Floods can result in loss of hay bales used for feed; loss of pasture lands; damage to farm buildings, equipment, and supplies; lower milk production; and loss of livestock, all of which cause adverse economic effects. As reported in Tillamook County, Oregon 1996 Flood Damage Assessment and Recovery Plan, prepared by Tillamook County, total agricultural damages from the 1996 flood event were reported to be about $9.2 million (NHC 2012). The report further indicated that 90 of 155 dairies in the County were affected by the flooding, and even 9 months after the flood, 25 to 30 were still "severely impacted." About 10 to 15 dairies have operations in the study area, and many or most of these would have been in the severely impacted category due to their location at the center of the flood damage (NHC 2012). The report indicates 7,200 acres of pasture were impacted by the flood, and 4,900 of these acres were damaged to the point that complete field renovation was required (NHC 2012).

The majority of the dairies in the County are members and owners of the Tillamook Creamery Cooperative Association (Co-op). Milk from the dairies is processed into various products, most notably cheese, at the Co-op factory in Tillamook. Losses of $750,000/month in production were reported for the Co-op following the 1996 flood. The Co-op production losses were incurred by loss of milk production from a small subset of the overall dairies. The total Co-op production loss was estimated to be $2,145,000 (NHC 2012).

The losses that have occurred in the past to residential, commercial, and agricultural structures and activities in previous floods could occur again in the event of another flood under the No Action Alternative. This would be a major, local, and significant adverse effect on the regional economy of Tillamook.

4.9.1.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Construction

Under the Proposed Action, construction activities would have a minor to moderate temporary benefit on the regional economy by providing construction employment and increasing sales in the region. Construction for the Proposed Action would occur intermittently from May 2016 through September 2017, which includes site preparation and project closeout. The majority of construction would occur from May through October 2016 and would require about 20 construction workers. Estimated costs for the project would be approximately $10 million, and annual operations and maintenance would be about $20,000, with an additional allowance of $150,000 every 10 years for less frequent repair and maintenance.

Construction would bring dollars to the local economy as any workers hired from outside the region would need to reside temporarily in the area and purchase local goods and services. Tillamook County has about 800 construction employees, and the City of Tillamook has about 140, so construction workers likely could be sourced from within the region. Workers who are local to the region would not result in increased economic activity as these workers spend money in the local economy with or without the project.

Spending on construction supplies and equipment also would boost the local economy. Tillamook County had construction earnings of $29 million in 2013 (Bureau of Economic Analysis 2014). The construction industry likely would be able to provide equipment and supplies for the project. Some supplies may need to be purchased outside the region and transported into the project area. Supplies purchased outside the region would not increase local economic activity. In general, construction activity would have a minor to moderate beneficial economic effect on the region during the period of construction.

Transition Period and Long Term

The Proposed Action would decrease potential for flood damage. As discussed under the No Action Alternative, previous flood damages have resulted in millions of dollars of losses in the regional economy. The Proposed Action would avoid some of these flood damages, which would be a major benefit to the local economy. As described in Section 4.5.1.3.2, some areas that currently flood under various flood recurrence events would remain dry with the Proposed Action. For example, almost 200 acres that currently flood in a 1.5-year event would remain dry, and almost 65 acres would remain dry in a 100-year event. Flood reduction that reduces or eliminates damages to pasture land and other elements of agricultural production would prevent or reduce losses due to decreased milk production. Avoided flood damages would be a benefit to future business operations for both POTB and the Tillamook Creamery because they would not be as affected by damage to structures and agriculture or reduced visitation. Avoided flood damages under the Proposed Action would be a major beneficial economic effect.

As discussed in Section 4.6.2, the Proposed Action would increase estuarine habitat, leading to increased fish and shellfish abundance and habitat and foraging opportunities for the entire suite of fish, wildlife, and invertebrate species in this ecosystem. Long-term effects on recreational activities as a result of the Proposed Action could affect the regional economy. Recreational fishing is an important component of the Tillamook regional economy. The Proposed Action would provide ecological benefits that could improve salmon and shellfish populations. The 2010 Hatchery Reform Report (ODFW 2010) estimated that each adult fall Chinook caught in Tillamook Bay by sport fishers provided a net economic value of $95.00 per fish. If an additional 3,120 adult fall Chinook salmon are harvested, the net economic value of additional production would be $296,400 annually. Section 4.6.2 discusses the effects of the Proposed Action on adult fall Chinook populations.

The opportunity for increased catch could attract new visitors to the area for fishing, crabbing, or clamming. Tidal restoration under the Proposed Action could also improve opportunities for birding activities. New visitors may be attracted to the area for bird watching and increase spending in the region. The average visitor spending along the Oregon Coast is $126 per visitor. Increased visitation for fishing, shellfishing, or bird watching and associated spending would be a direct benefit to the regional economy. This would be a major beneficial economic effect, depending on the magnitude of increases in fish and wildlife populations and associated increases in visitation to the County.

Effects on fish and shellfish populations could also benefit commercial fishing opportunities by increasing harvest. The Proposed Action would provide ecological benefits that could improve salmon rearing and growth of juveniles. This would result in lower mortality rates and increases in fish populations. Commercial fishing landings would increase because of increased salmon abundance and harvest. Participants in the ocean commercial fishery potentially affected by the Proposed Action likely consist primarily of small, independently owned and operated trollers. Increased catch could result in additional workers being needed and increased revenues for fishing boats. The ex-vessel value could increase relative to previous years. Some larger commercial operations based in Seattle that fish the Northern Oregon Coast may also benefit. Employment created in this sector could be full time or part time and include various types of services such as fishing; provision of fuel, bait, and ice; and other supporting jobs. Increases in fish landings and revenues under the Proposed Action would have a long-term, positive impact on employment, labor income, and output in the regional economy. This would be a major beneficial economic effect, depending on the magnitude of fish population increases and associated increases in catch.

Increased shellfish populations would also benefit commercial fishing by increasing harvest levels, similar to increases in fish populations described above. This could be a major beneficial economic effect, depending on the magnitude of shellfish population increases and associated increases in catch. Shellfish populations would be expected to increase partly due to the increased area of tidal wetlands but also due to the improvement in water quality in Tillamook Bay.

The Proposed Action would convert approximately 219 acres of land currently in pasture and hay production to restored floodplain and wetland habitat. As described under the No Action Alternative, this loss of land in current production could adversely affect the agricultural economy by decreasing farm revenues, reducing employment for farm workers, and decreasing sales of agricultural-support businesses. However, the difference in acreage of currently farmed land converted between the No Action Alternative and the Proposed Action would only be about 67 acres; therefore, there would be a negligible difference between the No Action Alternative and the Proposed Action, and this would be a less than significant impact.

The Proposed Action would also require the acquisition of an additional approximately 146 acres. About 21 acres of this would be leased back for agricultural uses, and presumably, the lease revenues would offset any potential property tax revenues that may be otherwise lost. Therefore, only 125 additional acres would be taken off the property tax rolls, which would be a negligible effect on County property tax revenues.

The Proposed Action would not conflict with local economic goals and objectives as defined in planning documents. The Proposed Action would result in beneficial effects by reducing future flood damages and supporting economic policies to promote regional economic development.

4.9.1.3.3 Alternative 2: Hall Slough Alternative

Under Alternative 2, construction phase and long-term economic effects would be similar to those described for the Proposed Action in type but would differ in magnitude.

Construction

Construction activities would temporarily benefit the regional economy by providing construction employment and increasing sales in the region. Construction for Alternative 2 would require about 18 construction workers. Estimated costs for the project are approximately $7.5 million in 2000 dollars. This cost has not been adjusted for inflation or other changes in costs; therefore, it is not directly comparable to the costs presented for the Proposed Action. Annual maintenance costs would be about the same as the existing maintenance costs because the new and setback levees would be about the same length as the existing levees. Similar to the Proposed Action, construction activity would be a minor to moderate economic benefit to the region during the period of construction.

Transition Period and Long Term

Alternative 2 would convert about 92 acres of currently farmed land to non-farm uses. Land not farmed as a result of Alternative 2 would adversely affect the agricultural economy and reduce County property tax revenues; however, the magnitude of the effect would be negligible as less than 1 percent of the agricultural land in the County would be affected. This impact would be less than significant. There would be no effect on City property tax revenues because where Hall Slough passes through the City, there is less opportunity to set back levees; therefore, there would be virtually no change in existing land uses or ownership.

Potential benefits to fish and wildlife populations and thus to recreational and commercial pursuits based on those natural resources would also be negligible as the amount of restored wetlands would be minimal. There would be an increase in potential habitat for anadromous salmonids, but it would be unlikely to result in a measurable increase in populations.

The Hall Slough Alternative would control flooding for “nuisance” floods that impact Highway 101 and the businesses in that corridor approximately every year or two (the 1.5-year recurrence interval). This would have a minor economic benefit. However, the Hall Slough Alternative would not affect the impact of larger floods on agricultural lands across the valley and thus would have a negligible effect on the regional economy in the event of a flood.

4.9.1.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Under Alternative 3, construction phase and long-term economic effects would be similar to or the same as those described for the Proposed Action.

Construction

Construction activities temporarily would benefit the regional economy by providing construction employment and increasing sales in the region. Estimated costs for the project are approximately $7.1 million in 2009 dollars. This cost does not include land acquisition costs. This cost has also not been adjusted for inflation or other changes in costs; therefore, it is not directly comparable to the costs presented for the Proposed Action. It is assumed this alternative would cost more than the Proposed Action when all costs are included, primarily because there would be more land acquired and somewhat more levee removal and construction. Annual maintenance costs are assumed to be similar to the Proposed Action, approximately $20,000 per year. Similar to the Proposed Action, construction activity, including employment and spending, would be a moderate beneficial economic effect to the region during the period of construction.

Transition Period and Long Term

Alternative 3 also would convert currently farmed agricultural land to restored floodplain and wetland habitat. Under Alternative 3, approximately 250 acres of farmland in current production would be converted indirectly to tidal wetlands, which is approximately 100 acres more than under the No Action Alternative. Land not farmed as a result of Alternative 3 could adversely affect the agricultural economy and County property tax revenues. The acreage converted under Alternative 3 would be about 1 percent of the agricultural land in the County and would result in a negligible adverse economic effect that would be less than significant.

Similar to the Proposed Action, there would major potential benefits to fish and wildlife populations and thus to recreational and commercial pursuits based on those natural resources. This would lead to a major beneficial economic effect due to increases in recreational and commercial fishing, shellfish harvest, crabbing, bird watching, and other related recreational pursuits.

Alternative 3 also would have a decreased potential for flood damage. As discussed under the No Action Alternative, previous flood damages have resulted in millions of dollars of losses in the regional economy. Alternative 3 would avoid some of these flood damages, which would be a major benefit to the local economy. The expected reduction in flooding would be similar to the Proposed Action; however, the acreage of pasture land that would remain dry under various flood events is expected to be somewhat smaller than under the Proposed Action. Flood reduction that reduces or eliminates damages to pasture land and other elements of agricultural production would prevent or reduce losses due to decreased milk production. Avoided flood damages would be a benefit to future business operations for both POTB and the Tillamook Creamery because they would not be as affected by damage to structures and agriculture or reduced visitation. Avoided flood damages under Alternative 3 would be a major beneficial economic effect.

4.9.2 Environmental Justice

This section describes existing minority and low-income populations within the study area, which includes populated areas near the potential project areas and evaluates whether the environmental impacts of each alternative would result in a disproportionately high and adverse impact on minority or low-income populations.

EO 12898, known as the Federal Environmental Justice Policy, requires that federal agencies identify and address disproportionately high and adverse human health or environmental effects on minority or low-income populations that result from their programs, policies, or activities. The executive order also tasks federal agencies with ensuring that public notifications regarding environmental issues are concise, understandable, and readily accessible. As stated in EPA guidance, disproportionately high and adverse effects encompass both human health and environmental effects. Informed judgment needs to be exercised as to what constitutes “disproportionate” as well as “high and adverse.”

Compliance with environmental justice requirements is also guided by Title VI of the Civil Rights Act, which prohibits discrimination on the basis of race, color, national origin, age, sex, or disability in programs and activities receiving federal financial assistance (Office of the Law Revision Council 2010).

4.9.2.1 Methodology

This section presents the methodology used in characterizing existing minority and low income population conditions in the study area. Census data are presented for the larger region (Tillamook County) and the smaller proposed project area (census tracts and block groups where appropriate) in order to identify any important contrasts. The census tracts in the study area are shown in **Table 4.9-7** and on **Figure 4.9-1**.

Table 4.9-7. Census Tracts Associated With the Study Area (2009-2013)

Census Tract	Population
Tillamook County	
9604	7,470
9605	2,407
9606	2,184
Total	12,061

Source: U.S. Census Bureau 2013

The analysis completed in this section identifies the potential for the alternatives to result in disproportionately high and adverse effects on minority or low-income populations. First, locations of minority populations and low-income populations in the study area were identified using the most recent block group level data from the 2009-2013 American Community Survey (ACS). Minority or low-income census tracts are defined as meeting either or both of the following criteria:

- The census block group contains 50 percent or more minority persons or 25 percent or more low-income persons.
- The percentage of minority or low-income persons in any block group is more than 10 percent greater than the average of the surrounding County.

Minority persons are defined as all people not identified as White only, plus White-only people identified as Hispanic or Latino. Low-income persons are defined as those individuals with incomes below the census poverty threshold.

Secondly, any projected substantial effects on environmental resources (socioeconomics, air quality, historic properties, aesthetics and visual, microclimate, human health and safety, public services and infrastructure, land use and planning, transportation, and noise) were reviewed to determine if environmental justice communities would be disproportionately affected in terms of frequency and/or magnitude of these impacts as compared to other populations in the proposed project area.

4.9.2.2 Affected Environment

This section describes the existing minority and low-income populations within the Tillamook region and the study area.

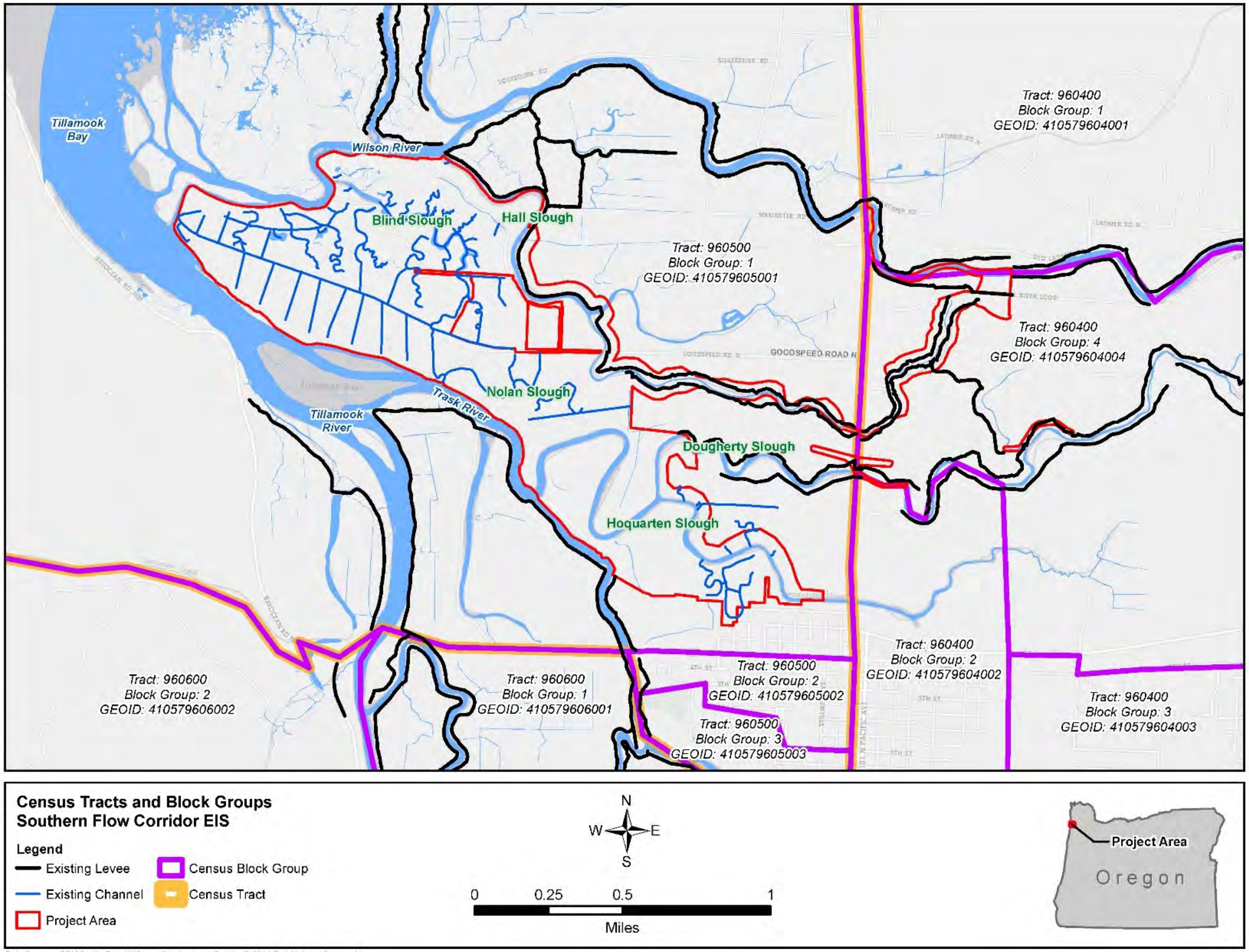


Figure 4.9-1. Census Tracts and Block Groups within the Study Area

4.9.2.2.1 Regional Demographics

This section provides a description of regional minority and low income population demographics. Demographics are presented at the County (Tillamook County) and census tract levels. Tillamook County had a minority population in the 2009-2013 ACS that represented approximately 14 percent of the population (**Table 4.9-8**). The three census tracts in the study area had minority populations in the 2009-2013 ACS that ranged from approximately 10 percent to 25 percent of the tract's total population.

Table 4.9-8. Minority and Poverty Status Breakdown

County	Census Tract	Population	Minority		Below the Poverty Level (Percent)
			No. Persons	Percent	
Tillamook County		25,300	3,488	13.79	16.15[1]
	9604	7,470	1,293	17.31	17.40
	9605	2,407	581	24.14	25.38
	9606	2,184	225	10.30	10.90

Source: U.S. Census Bureau 2010

Notes:

1 - Percentage calculated based on population for whom poverty status was determined in the 2009-2013 ACS (3,963 individuals out of a population of 24,542)

4.9.2.2.2 Study Area Demographics

This section provides a description of minority and low income population demographics in the study area presented at the block group level.

In the study area, there are several census block groups where the percentage of people with incomes less than the poverty level are higher than the County percentages identified in the 2009-2013 ACS (U.S. Census Bureau 2010). Census block group data are shown in **Table 4.9-9**, and the block group locations are shown on **Figure 4.9-1**. The block groups included in the table are the block groups within the larger census tracts identified in **Table 4.9-8** and include those that are in the study area.

Based on the environmental justice criteria presented in the methodology section above, the following census block groups containing the proposed project areas and the areas immediately adjacent to the study area represent low-income communities:

- Census tract 9604, block group 2 (28.8 percent of the household population under the poverty level)
- Census tract 9605, block group 1 (41.0 percent of the household population under the poverty level)

In the study area, total minority percentages in several census block groups are higher than the County percentages (U.S. Census Bureau 2010). These data are shown in **Table 4.9-9**.

Table 4.9-9. Minority and Low-Income Populations Adjacent to the Study Area

Census Tract	Block Group	Total Population	White Only	Black Only	American Indian and Alaska Native Only	Asian Only	Native Hawaiian and Other Pacific Islander alone	Other and Mixed	Hispanic or Latino	Total Minority		Below the Poverty Level (%)
9604	1	625	466	0	0	17	0	0	58	159	25.44	13.44
	2	979	962	0	17	0	0	0	0	17	1.74	28.80
	3	1,778	1,518	0	0	0	50	0	185	260	14.62	27.56
	4	757	430	0	0	0	0	0	327	327	43.20	0.00
9605	1	1,019	556	0	0	0	0	0	444	463	45.44	41.02
	2	836	801	1	0	1	0	0	21	35	4.19	12.20
	3	552	469	0	0	18	0	0	44	83	15.04	16.49
9606	1	359	317	0	0	20	0	0	10	42	11.70	15.60
	2	1,057	959	5	0	17	0	0	50	98	9.27	9.56

Based on the environmental justice criteria presented above, the following census block groups represent minority environmental justice communities:

- Census tract 9604 block group 1 (25.4 percent)
- Census tract 9604 block group 4 (43.2 percent)
- Census tract 9605 block group 1 (45.4 percent)

4.9.2.3 Environmental Consequences

This section discusses the potential effects of the action alternatives and the No Action Alternative on environmental justice populations in and near the study area. Impacts related to environmental justice were evaluated for each of the project alternatives to determine whether the alternative would generate a disproportionate and adverse effect on minority and low-income populations in the study area. If there would be a disproportionate and adverse impact on an environmental justice population, then the alternative would potentially have significant impacts, and mitigation measures would need to be developed with the community to mitigate those effects.

4.9.2.3.1 No Action Alternative

Construction, Transition Period, and Long Term

Under the No Action Alternative, there would be no construction in the project area, existing levee configurations would remain the same, and there would be no change in flood elevations. In the absence of a flood, the No Action Alternative would have no effect on environmental justice populations.

Under the No Action Alternative, it is possible that a flood could impact environmental justice populations in the study area. Numerous studies of the effects of floods on socially vulnerable communities, including minority and low-income communities, at locations across the United States have identified disproportionate impacts in the form of both property damage and loss of life. The causes of these impacts have been linked to levels of access to hazard warning before floods, mobility necessary to avoid floods, and access to refuge, either local or regionally, for evacuation. Studies have also identified lower levels of use of flood insurance amongst socially vulnerable populations and lower reliance on disaster relief provisions provided to impacted populations following floods (Zahran et al. 2008).

The census blocks with minority and low-income populations that meet the definition of an environmental justice community occur in the area along the Wilson River and between the Wilson River and Dougherty and Hall sloughs (i.e., in the areas where the greatest amount of flooding occurs). While floods in the Tillamook Valley generate widespread damage across the entire study area, the impacts generated by this flooding have the potential to disproportionately and adversely affect environmental justice populations.

4.9.2.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Construction

Potential construction impacts would not disproportionately adversely affect environmental justice populations in the study area, given the separation between the project area and populated areas and the dispersed nature of construction traffic and noise impacts that would affect all populations in the study area.

Transition Period and Long Term
Under Alternative 1, approximately 320 acres of land that is currently utilized for agriculture would be converted to restored floodplain and wetland habitat. This land is currently managed for low-intensity grazing and hay production, and its conversion would not be anticipated to result in a measurable reduction in the need for agricultural labor. Therefore, the conversion to tidal wetlands would not adversely affect members of the environmental justice population in the study area. Recreational access for non-fee paying visitors in the project area is also not expected to change following implementation of Alternative 1, and there would be no disproportionate effects on environmental justice populations anticipated from the alternative. Any potential reduction in flood elevations or flood damages that would result from implementation of Alternative 1 would have a major, regional, beneficial effect on environmental justice populations in the study area.

4.9.2.3.3 Alternative 2: Hall Slough Alternative

Construction
Potential construction impacts would not disproportionately impact environmental justice populations in the study area, given the separation between the project area and populated areas and the dispersed nature of traffic and noise impacts that would affect all populations in the study area.

Transition Period and Long Term
Under Alternative 2, approximately 92 acres of land along Hall Slough currently used for agriculture would be converted to non-agricultural uses. This land is currently generally managed for low-intensity grazing, and its conversion would not be anticipated to result in a measurable reduction in the need for agricultural labor and as a result would not adversely affect members of the environmental justice population in the study area. There is virtually no recreational access along Hall Slough, and this is not expected to change following implementation of Alternative 2. Therefore, there would be no disproportionate effects on environmental justice populations. The anticipated reduction in small annual floods along Hall Slough and across Highway 101 could have a moderate, regional, beneficial effect on environmental justice populations located in that corridor.

4.9.2.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction
Under Alternative 3, potential effects on environmental justice populations would be very similar to those described for the Proposed Action because the activities would be similar in location and scope. Potential construction-related effects would not be expected to disproportionately affect environmental justice populations in the study area.

Transition Period and Long Term
Alternative 3 would convert more agricultural land that is currently in active production to tidal wetlands than Alternative 1 (approximately 253 acres versus 219 acres of currently farmed land), and this would not be anticipated to result in a measurable reduction in the need for agricultural labor. Any potential reduction in flood elevations or flood damages that would result from

implementation of Alternative 1 would have a major, regional, beneficial effect on environmental justice populations in the study area.

4.9.3 Public Health and Safety

This section describes the current conditions with respect to public health and safety, including existing hazards such as flood and fire risk, vector control, emergency response plans, the location of local emergency services (e.g., hospitals, fire stations, police), and important evacuation and other emergency transportation routes in the project area. The section also presents an evaluation of the potential effects of the project alternatives on public health and safety during construction from potential road closures. Potential long-term effects due to changes in hydrology and the potential for flooding of structures, roads, and bridges in the valley are discussed.

The NOAA National Weather Service office, located in Portland, Oregon is responsible for the tsunami forecast and warning program and alerting the public of tsunami warnings, advisories, and watches through their webpage.

The Oregon Office of Emergency Management (OEM) is responsible for coordinating and facilitating emergency planning, preparedness, response, and recovery activities with the state and local emergency services agencies and organizations. DOGAMI is responsible for outreach to coastal residents for emergency preparedness related to earthquake and tsunami hazards.

In addition, Oregon state planning guidelines specify new development must consider flooding, landslides, and other hazards. Projects involving modification of established drainage patterns should be evaluated in terms of the effect these changes would have on drainage and slope stability (Tillamook County 1982).

The Tillamook County Public Works Department manages emergency transportation routes, identifies road hazards, implements road closures, and maintains mapping capabilities and equipment. Staff and resources are assigned to support emergency evacuation and essential transportation routes (Tillamook County Department of Emergency Management 2007). The Tillamook County Division of Emergency Management coordinates the emergency relocation and evacuation of the population in the event of an emergency. Evacuation instructions and information for the public are disseminated using media partners, door-to-door contacts, sirens, and public address systems.

The Tillamook County Division of Emergency Management's Emergency Operations Plan describes the coordinated response and recovery activities to be conducted during any type or size of emergency situation (Tillamook County Department of Emergency Management 2007).

The Stillwell Drainage District is charged with maintaining a levee surrounding properties located between the lower Trask and Tillamook rivers. The property for which the Stillwell Drainage District is responsible is adjacent to but outside of the project area, south of the Trask River.

4.9.3.1 Affected Environment

This section describes the affected environment for the study area, which includes the larger Tillamook basin because basin-wide health and safety issues could both impact and be affected by proposed actions within the narrower project areas. The affected environment includes the emergency response resources available both in the project area and in the larger study area.

4.9.3.1.1 Study Area

The Wilson, Trask, and Tillamook rivers pass through the Tillamook Valley to Tillamook Bay, creating a large floodplain vulnerable to severe flooding. The City of Tillamook lies along a ridge that separates the Wilson and the Trask rivers; just downstream of the City is Tillamook Bay. The Wilson and Trask rivers are the two largest rivers that flow into Tillamook Bay and produce the largest floods.

As described in Section 4.5.1, Floodplains, the SFC study area includes approximately 7.6 acres of moderate flood hazard areas, 1.1 acres of minimal flood hazard areas, and 656.9 acres subject to flooding during a 100-year flood as shown on FEMA flood insurance rate maps. The Hall Slough Alternative project area is also primarily located within areas subject to flooding during a 100-year flood, with a smaller portion of moderate flood hazard areas.

The Wilson River has reached flood stage numerous times in past years; between 1973 and 2005, it exceeded flood stage approximately 60 times, averaging almost two floods per year in the recent past (USACE 2005). Heavy rains in the mountains to the east cause the rivers to rise quickly and, when combined with high tides, the Tillamook area floods.

The City and County of Tillamook have repeatedly experienced severe floods, and in recent years, the community has implemented several flood mitigation projects to reduce damage from future floods. The downtown core largely remains flood free; however, developed areas to the north and south of downtown regularly experience significant flooding. The worst flooding occurs north of the City along the Highway 101 business area. This regular flooding creates hazards to public health and safety through direct dangers to life and property and through impacts on emergency access and response.

By virtue of its location on the Oregon Coast, the study area is subject to tsunami hazards as described in Section 4.7.1.1. None of the alternatives would alter the existing condition with respect to tsunami hazards nor would they affect local or state emergency response plans with respect to this hazard.

The proposed project areas currently contain many wetlands that may be breeding grounds for mosquitos that can be disease vectors as described below in Section 4.9.3.1.4. As a byproduct of the dairy industry, cow manure is spread over a significant portion of the study area, both randomly in pastures and methodically in hay fields. Manure may contain a variety of pathogens that could pose a public health risk. Risks may arise either from direct contact with treated areas or indirectly if stormwater carries pathogens into waterways and to fish or shellfish in the rivers and bay. Pathogens in manure typically break down very quickly in soils, with public health concerns becoming minor within a matter of days (Brooks et al. 2012; Pachepsky et al. 2006). Under the Proposed Action and Alternative 3, manure application would be discontinued in many areas. Pathogens may persist for longer periods when carried into waterways and may even reproduce if the conditions are favorable (Pachepsky et al. 2006).

The proposed project areas include both the SFC project area and the Hall Slough Alternative project area that are currently managed mostly for agricultural land uses. There are few permanent residents within either project area though there are a number of residences adjacent to the project areas. Demand for police and fire protection within the project areas is therefore negligible, with the exception of potential demand for emergency services required by agricultural workers or recreational visitors in and around the adjacent waterways. The emergency service providers described above for the study area currently provide emergency response resources for these users.

4.9.3.1.2 Emergency Access

Highway 101 is the major north/south transportation corridor along the coast, and the Wilson River Highway (Oregon Highway 6) from Tillamook to Portland provides one of the only access roads across the Coast Range in the vicinity of the project. OR 131 is a primary east/west roadway from Tillamook to Netarts and then onto Oceanside and other communities along the coast. Other major access routes for areas adjacent to the study area include Bayocean Road, Goodspeed Road, and the Wilson River Loop.

Highway 101 regularly floods in low areas between Hoquarten Slough and the Wilson River. Hall Slough routinely overtops and floods the highway even during small 1- to 2-year flood events. This can cause delays in emergency access as alternate routes north and south across the valley are limited.

Flooding during 5-year flood events and greater can close Highway 101 between Hoquarten Slough and the Wilson River, depending on tidal influence. In larger events, such as in 2007 (a 22-year flood event), floodwaters may also close off Wilson River Loop at the north side of the second bridge on Wilson River Loop. When this happens, the north part of the County is cut off from central and south Tillamook County. This impacts ambulance service and access to the hospital and other emergency services.

4.9.3.1.3 Emergency Services

The primary location for the County Emergency Operations Center is the main conference room of the Tillamook County Justice Facility located at 5995 Long Prairie Rd (Tillamook County Department of Emergency Management 2007). If necessary, the operational/tactical operations could be located in the Tillamook County Emergency Communications (911) center located at 2311 3rd Street if the primary facility is rendered inoperable. Tillamook Regional Medical Center Emergency Department (Tillamook General Hospital) is located at 1000 3rd Street.

The Tillamook Fire District operates out of three fire stations and is dispatched by the Tillamook County Emergency Communications District. The main fire station is located within the City of Tillamook at 2310 4th Street. The district provides fire protection and emergency services to approximately 11,000 full-time residents who live within the district boundaries of the City of Tillamook and the surrounding rural area (Tillamook Fire District 2014).

The City of Tillamook Police Department patrols within the City limits. The Tillamook County Sheriff's Department provides police protection on an on-call basis in unincorporated areas of the County. The Oregon State Police provide traffic patrol, game patrol, and criminal investigation services in the County. The headquarters for police services are in the City of Tillamook (Tillamook County 1982).

The Tillamook Airport is a public use airport located at 5005 Highway 101 South, about 3 miles south of the central business district of Tillamook.

4.9.3.1.4 Vector Control

The study area harbors mosquito populations that spike in the warmer late spring and summer months. West Nile Virus is an arbovirus most commonly spread by bites from infected mosquitos. West Nile Virus is conveyed by infected mosquitos to birds, horses, people, and other mammals. The virus can concentrate to levels in birds sufficiently to allow transmission to other mosquitos; however, horses, people, and other mammals are dead end hosts and cannot transmit the disease to other humans or back to mosquitos (Centers for Disease Control and Prevention [CDC] 2015). The Oregon Health Authority Public Health Division monitors for West Nile Virus across Oregon, and as of 2014, the virus had not yet been detected in Tillamook, Oregon (Oregon Health Authority 2014). As part of the studies of existing conditions on the SFC study area, USFWS will be funding the collection of baseline data on mosquito populations in 2015 to determine the species that occur in the area and gather information on population levels.

4.9.3.3 Environmental Consequences

This section describes the potential environmental consequences related to public health and safety from implementation of each of the project alternatives. Impacts to public health and safety are measured in this section by considering whether implementation of the alternatives would increase hazards from flooding or whether there would be moderate to major reductions in levels of emergency services and response times. Public health and safety impacts would be significant if they would increase risks to human life or health during construction or over the long term during maintenance of new or modified structures. Indirect impacts might include effects on emergency access or response times during construction or long-term maintenance by introducing construction-related traffic to study area roadways that slows or blocks emergency vehicles.

As described in Section 4.4.2, Traffic, the main roads that would be used during construction of all of the action alternatives would include Highway 101, Goodspeed Road, OR 131 and local roadways north of OR 131 in central Tillamook, and the Wilson River Loop. Based on the analysis in Section 4.4.2, there would be minor impacts to traffic under all of the action alternatives. Therefore, potential impacts to emergency access or services on roadways would not be significant.

4.9.3.3.1 No Action Alternative

Construction, Transition Period, and Long Term

Under the No Action Alternative, existing conditions described above in the affected environment section would not change, and regular flood events that impact the study area would be expected to continue. Public health and safety impacts in the project area under the No Action Alternative would not change. Ongoing regular flooding events would however continue to create the potential for significant public health and safety impacts on inhabitants of areas currently impacted by flood events. This includes the developed areas along Highway 101 north of Hoquarten Slough. These flood events would also continue to impair adopted emergency response plans, emergency evacuation plans, and/or emergency service vehicles' access and response capabilities and generate significant adverse impacts to public health and safety.

Under the No Action Alternative, flooding would continue to close Highway 101 between Hoquarten Slough and the Wilson River. Large flood events, such as occurred in 2007, will also continue to close off part of Wilson River Loop, resulting in major, local, adverse impacts on emergency services, ambulance service, and access to the hospital and would continue to be significant.

The No Action Alternative would not generate new habitat for mosquitos in the study area. Agricultural workers and recreation visitors to the area currently encounter mosquitos during the summer months, and this would not be anticipated to change in the future.

The No Action Alternative also would not change the existing conditions with respect to the application of manure in the short term. While most of the study area where manure is applied is not generally accessible to the public, existing conditions whereby some pathogens may reach surface waters would not change. Over the long term, agricultural uses would be expected to be phased out on the County-owned land, which would reduce the area where manure may be applied. This would be a minor, local, beneficial effect on public health.

4.9.3.3.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Construction

During construction, major, local, impacts to public safety would exist from the presence of heavy construction equipment on roads and near recreational areas and the potential impairment of emergency operations. These impacts would be significant. Potential impacts include injury or death from contact with heavy machinery and construction vehicles and falling and/or entrapment in excavation areas. There also would be the potential for major, significant impacts to the safety of construction workers themselves from any flood events that occurred during construction.

During construction, the site would be closed to public access for recreation. Construction vehicles on public roads, such as Goodspeed Road, would be required to obey speed limits and to ensure loads are covered and vehicles are free of loose debris that could come loose during travel and pose a hazard to the public. Measures, such as public notification of construction activities, signage, and fencing, would be used to exclude the public from dangerous work areas. With implementation of these BMPs (also described in Section 6), potential impacts to public safety would be minor, local, and less than significant.

To protect construction workers, a worker health and safety plan would be prepared by the contractor on site to ensure safety procedures are understood and followed by all workers. This plan would also include an emergency response plan that would address potential hazards, emergency response, and escape routes (29 CFR 1926.35). The construction schedule as noted in Section 3.4.2 is set to coincide with the late spring through early fall period when the likelihood of major rainfall events is at its lowest.

In addition, the proposed construction sequencing would prevent high tides from impacting landowners adjacent to the proposed project area. All new setback levees would be constructed prior to the removal of perimeter levees. Once the perimeter levees are removed, only the wetland restoration area would be affected by high tides.

With implementation of these mitigation measures, impacts to public health and safety during construction of the Proposed Action would be minor and less than significant.

Transition Period and Long Term

Potential long-term major adverse impacts include the opportunity for increased flooding if construction activities compromise the integrity of existing levees or other structures, such as floodgates, such that leakage and/or flooding occurs. These impacts would be significant. In addition, potential changes in hydrology could result in the flooding of new areas. Flooding can endanger public safety from direct harm to individuals and property and from impairment of access for emergency vehicles and if individuals become isolated by high water. The modifications to and replacement of existing infrastructure were designed by licensed professional civil and structural engineers, and the construction work would be performed by licensed professional contractors. Modification and replacement of existing structures under Alternative 1 is anticipated to result in moderate reductions in flood damages throughout the study area.

Concerns posed by the Stillwell Drainage District include the potential for increased flooding in the area south of the Trask River. The concern is that if levees on the north side of the Trask River are removed, floodwaters could flow south towards the Drainage District's area of responsibility in a greater volume than at present. In addition to the large number of cattle, feed, and buildings located within the Stillwell Drainage District, the district also holds the local radio station, which dispenses information during an emergency. The district includes OR 131, which links Oceanside, Netarts, and Cape Meares to medical and emergency facilities during flooding events. Therefore, if Alternative 1 resulted in increased flooding risk to the Stillwell Drainage District, this would be a significant impact.

However, modeling indicates the Proposed Action provides flood level reductions across most of the lower Wilson River floodplain for all but the very small annual flood events. Potential project elements, such as removal of riprap in some locations, could be used to provide additional long-term protection of levees in some places. For example, the proposed removal of 2,025 linear feet of riprap along the north side of the Trask River, north of the Stillwell Ditch, where the river flows to the north before turning west, would allow flood flows from the Trask River to move into the project area. Over the long term, this also would allow more sediment to accrete on the south bank, which would provide additional protection of properties located to the south, including those associated with the Stillwater Drainage District. Hydraulic modeling is being used to inform the engineering design process and ensure there is no increased risk of flooding to properties outside the project boundary.

As described in Section 4.7.1 Geology and Soils, a geotechnical investigation was conducted to evaluate slope stability, settlement, seepage, and seismic issues related to the proposed new setback levees (Shannon & Wilson, Inc. 2014). The geotechnical report recommended modifications to the proposed engineering design to move the north, middle, and south levees back further from adjacent channels; monitoring of pore water pressures in certain areas of the levees using piezometers; and installation of a toe drain in the middle levee floodgate. These recommendations were incorporated into the engineering designs to improve the long-term integrity of proposed new and modified levees and ensure long-term impacts would be less than significant.

Emergency Services

As noted above in the affected environment discussion, there are few permanent residents in the SFC project area. Under the Proposed Action, the Diamond F house would be purchased and demolished, and there would be no permanent residents within the project area following implementation. Given this lack of residents in the project area, the alternative would not result in any new demand for new or expanded emergency services (e.g., police, hospitals, fire stations). In addition, the flood reduction benefits would not be likely to result in new development occurring within local emergency service providers' service areas that would not also occur under the No Action Alternative. Therefore, there would be no impact on emergency services.

The Proposed Action would reduce flood extent and duration during 5-year and greater flood events. Closures of Highway 101 and the Wilson River Loop would be reduced in duration, providing a major, regional, long-term benefit to emergency access and response.

Vector Control and Pathogens

Alternative 1 would generate new habitat for mosquitoes in the project area in the form of new tidal marsh and wetland habitat. The development of new mosquito habitat in the project area could cause an increase in the total mosquito population's size, and the removal of trees could cause localized increases in mosquito population density by increasing the amount of solar radiation able to reach larval habitats (Leisnham et. al. 2005).

Saltwater mosquitoes are known to be aggressive biters and occur in very large numbers that are more problematic as compared to freshwater species. However, many of the existing potential breeding areas within the project area are currently brackish and would support saltwater mosquito species if they are present. Also, large areas to the north of the mouth of the Wilson River are currently saltwater marsh and would also be an existing potential breeding area for saltwater mosquito species.

Agricultural workers and recreation visitors to the project area currently encounter mosquitoes during the summer months and are accustomed to dealing with their presence. The presence of mosquitoes in the future would, as noted, not be expected to change. Prior to construction, USFWS is funding monitoring for the presence or absence of mosquitos and to identify the species that are present. This will form the basis against which future mosquito issues will be evaluated and provide a guide for when adaptive management actions may be necessary.

At the Bandon Marsh National Wildlife Refuge marsh restoration project site, salt marsh mosquitoes did become a problem following construction. In response, the USFWS is working to drain mosquito breeding ponds that were inadvertently formed during the restoration process (USFWS 2015a). By draining areas of standing water, the need to apply larvicides should be eliminated. The Proposed Action does not intend to create ponded areas, but it is possible that some may inadvertently form. There are also some existing areas, such as the old log ponds on the Sadri property, that likely hold water year round. While the levee between the log ponds and Hoquarten Slough would be removed, the ponded area might still be expected to hold water and could support mosquito larvae. Since this area already holds some water for extended periods, the proposed project is unlikely to result in a significant change in the existing condition. Over the long term, issues related to mosquitoes would be informally monitored, and action to drain ponds or apply larvicides would be implemented if necessary to reduce impacts to less than significant.

The Proposed Action would reduce the area where manure is currently applied to hay fields or deposited in pastures by approximately 320 acres. This would represent a minor reduction in areas treated with manure. Because the pathogens do not persist in the soils for extended periods of time, there would be no impact on construction workers or to recreationists following construction.

Summary of Effects

Through comprehensive modeling and design to ensure the long-term integrity of new and modified levees and other structures and implementation of public and worker safety plans during construction, potential adverse impacts to public health and safety under Alternative 1 would be minor, local, and less than significant. Long-term, local effects on public health and safety would be beneficial from reduced flooding risk and decrease in manure application. Minor, local, long-term impacts from increased mosquito populations could occur, although more study is needed to verify whether this would occur. This potential impact would be less than significant.

4.9.3.3.3 Alternative 2: Hall Slough Alternative

Construction

Similar to Alternative 1, during construction, potentially major, local, adverse impacts to public safety would exist from the presence of heavy construction equipment on roads and from the potential impairment of emergency operations. These impacts would be significant. Potential impacts include injury or death from contact with heavy machinery and construction vehicles and falling and/or entrapment in excavation areas. Unlike the Proposed Action, there are a number of residences and businesses immediately adjacent to the work zone. Therefore, there may need to be greater use of exclusion fencing to keep people out of active construction areas. Also, under the Hall Slough Alternative, it is likely there would be more construction-related traffic on local roads as equipment moves along the linear project area. The same BMPs and safety plans would be required as described for the Proposed Action. With implementation of these BMPs (also described in Section 6), potential impacts to construction workers and the public would be minor and less than significant.

Transition Period and Long Term

The Hall Slough Alternative would contain the annual 1-to 2-year floods that impact the Highway 101 business district (USACE 2005). Modeling results indicate the modified Hall Slough would carry approximately 1,000 cfs of floodwater that would have previously flooded Highway 101. The Hall Slough Alternative also would reduce the duration of flooding on Highway 101 by approximately 4 hours. Highway 101 is a critical north-south connector across the Tillamook Valley for emergency services, and when it is flooded, it can impact response times. Therefore, the Hall Slough Alternative would have a beneficial effect on public health and safety by reducing emergency response times during common flooding events.

Emergency Services

The boundaries of Alternative 2 do not encompass permanent residents although there are several immediately adjacent to the project area. Alternative 2 would not result in any new demand for new or expanded emergency services (e.g., police, hospitals, fire stations). In addition, the flood reduction benefits would not be likely to result in new development occurring within local emergency service providers' service areas that would not also occur under the No Action Alternative. Therefore, there would be no impact to emergency services.

Vector Control and Pathogens

Some new habitat for mosquitoes could be generated in the project area in the form of new tidal marsh and wetland habitat. However, the potential area of tidal wetland restoration would be much smaller than under the Proposed Action (90 acres versus 522 acres), and the setback levees and slough widening would be much less likely to inadvertently create breeding ponds. Under Alternative 2, there would be no change in the potential for mosquito breeding throughout the larger SFC study area. Agricultural workers and recreation visitors to the project area currently encounter mosquitoes during the summer months and are accustomed to dealing with their presence. The presence of mosquitos in the future would not be expected to change, and there would be no impact.

Alternative 2 would reduce the area where manure is currently deposited in pastures by approximately 92 acres. This would represent a minor reduction in areas receiving manure. Because the pathogens do not persist in the soils for extended periods of time, there would be no impact on construction workers or to recreationists following construction.

Summary of Effects

With implementation of public and worker safety plans during construction, potential impacts to public health and safety under Alternative 2 would be minor and less than significant. There would be long-term, beneficial impacts on public health and safety from reduced flooding risk.

4.9.3.3.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction

Alternative 3 would have the same potentially major, local, adverse impacts on emergency services, public and construction worker health and safety during construction, and public health and safety following construction. These impacts would be significant. In the long term, closures of Highway 101 and the Wilson River Loop due to flooding would be reduced in duration, providing a significant benefit to emergency access and response.

Transition Period and Long Term

Based on modeling, the Southern Flow Corridor – Initial Alternative would provide flood level reductions across most of the lower Wilson River floodplain at all sizes of floods. Although Alternative 3 would not reduce flood levels in the area between Hall Slough and the Wilson River as much as the Proposed Action, the difference would be minor.

Vector Control and Pathogens

Although Alternative 3 would restore more acres of wetlands (568 acres versus 522 acres), the effect of Alternative 3 on potential mosquito populations or the presence of pathogens from manure is not expected to be measurably different from the Proposed Action. Therefore, the effect of Alternative 3 on disease vectors and pathogens would be the same as under the

Proposed Action. The same BMPs would be applied to Alternative 3 as described for the Proposed Action to ensure impacts are minor and less than significant.

Summary of Effects

Through comprehensive modeling and design to ensure the long-term integrity of new and modified levees and other structures and implementation of public and worker safety plans during construction, potential impacts to public health and safety under Alternative 3 would be less than significant. Long-term effects on public health and safety would be negligible.

4.9.4 Recreation

This section describes existing recreation resources within the study area, which includes specific recreation sites near the potential project areas along with broader study area recreation activities that could be influenced by conditions in each project area, and evaluates whether the environmental impacts of each alternative would result in impacts on these recreation resources.

Recreation and tourism are important components of the local economy. The Oregon Coast is a major draw for recreationists as are the opportunities for fishing and shellfish harvesting. The 1967 Beach Bill established the Oregon Coastline as a state recreation area administered by the Oregon Parks and Recreation Department. This extensive protected coastline draws visitors to the Oregon Coast and the Tillamook area.

The Tillamook County Comprehensive Plan provides for the protection of coastal and estuarine resources that protect access to natural areas and contribute to recreation and water-dependent resources such as fishing. The City of Tillamook's Comprehensive Plan contains multiple policies that direct the City to protect natural and scenic resources and develop recreational opportunities that capitalize upon the natural environment of the area. State and local policies related to recreational resources are described in more detail in Appendix C.

4.9.4.1 Affected Environment

Tillamook County offers a number of recreation activities, including fishing, kayaking, bird watching, and visiting tourist attractions such as beaches, state parks, and the Tillamook Cheese Factory. The study area and adjacent areas provide multiple opportunities for recreation access to natural areas with multiple boat launches, bird watching sites, and walking trails. The larger study area includes opportunity for boat-based fishing, shellfish harvesting, crabbing, and recreational boating, including kayaking.

A report on Oregon Coast tourism estimated $1.6 billion was spent on overnight trips along the Oregon Coast in 2013. About 67 percent of the visitors were from Oregon, 18 percent from Washington, 5 percent from California, and 2 percent from Idaho (Longwoods Travel USA 2013). Recreational activities along the coast vary, with 60 percent of visitors visiting beaches, 25 percent visiting landmarks or historic sites, 17 percent going hiking, 12 percent going fishing, and 3 percent going birding (Longwoods Travel USA 2013).

As described in detail in Section 4.6.2, fish species utilizing the study area are varied and seasonal, including a diverse assemblage of marine, freshwater, and estuarine species in the project vicinity. The Trask, Tillamook, and Wilson rivers contain important salmonid game species, including three species of salmon, two species of anadromous trout, multiple species of sculpin, and resident non-migratory trout.

Tillamook Bay offers recreational fishing for Chinook salmon, steelhead, sturgeon, crab, and shellfish. Fall Chinook salmon are the most popular fish for sport fishing in Tillamook Bay. Recreational sport fishing is generally open for spring Chinook salmon prior to August 1 and for fall Chinook salmon from August 1 to December 31. The specific dates are set annually by ODFW. **Table 4.9-10** shows salmon angler trips in the Tillamook catch area. **Table 4.9-11** shows catch by number of fish in the Tillamook catch area.

Table 4.9-10. Oregon Ocean Recreational Salmon Angler Trips in Tillamook Catch Area

Month	2008	2009	2010	2011	2012	2013
March	-	-	-	0	0	2
April	-	-	-	10	38	78
May	-	-	100	100	567	381
June	600	1,000	1,200	900	830	677
July	1,300	10,500	3,800	3,800	2,372	3,294
August	1,200	7,100	3,600	3,000	2,933	2,989
September	3,600	1,800	3,700	3,700	4,126	3,494
October	2,300	2,000	1,000	1,200	1,521	3,989
November	-	-	-	-	-	-
Total	9,100	22,400	13,500	12,800	12,387	14,904

Source: ODFW 2014a

Table 4.9-11. Oregon Ocean Recreational Chinook Salmon Catch in Tillamook Catch Area (Number of Fish)

Month	2008	2009	2010	2011	2012	2013
March	-	-	-	0	0	0
April	-	-	-	0	1	21
May	-	-	<50	<50	79	32
June	<50	<50	100	<50	102	82
July	-	<50	100	100	133	189
August	<50	<50	200	200	429	229
September	300	100	300	600	1,008	779
October	200	200	100	200	419	719
November	-	-	-	-	-	-
Total	500	400	800	1,100	2,171	2,051

Source: ODFW 2014b

Recreational crabbing in Oregon bays, including Tillamook, occurs year round. The ocean has an annual closure from October 16 through November 30. Catch is typically highest in the late summer and fall (August-October). Bay crab fishing accounts for most of the statewide harvest, totaling approximately 60 percent (ODFW 2012). The most recreational crabbing trips recorded occurred in 2009, with an estimated 130,000 trips. **Table 4.9-12** shows estimated monthly crabbing trips in Tillamook Bay from 2008 through 2011. The monthly harvest of crabs for all years sampled was the highest in September 2011 when close to 35,000 crabs were harvested (ODFW 2012). Harvest in April through July in all years is low due to a combination of low effort and decreased catch rates. The estimated annual harvest of Dungeness crab in Tillamook Bay during the period sampled was 66,200 pounds in 2008, 45,600 pounds in 2009, 49,400 pounds in 2010, and 85,300 pounds in 2011 (ODFW 2012).

Table 4.9-12. Monthly Crabbing Trips in Tillamook Bay 2008 through 2011

Month	2008	2009	2010	2011
April	89	663	451	320
May	229	1108	814	641
June	378	479	630	203
July	575	1958	788	631
August	1373	1721	1589	1330
September	1426	1536	1531	2512
October	2370	Not sampled	1276	Not sampled

Source: ODFW 2012

About half of the recreational crabbers in Tillamook Bay interviewed in the ODFW survey traveled less than 50 miles, but over 11 percent traveled over 150 miles. Almost 85 percent of all crabbers were Oregon residents, and nearly 10 percent traveled from Washington. Most crabbers in Tillamook Bay traveled from the northern Willamette Valley area or were local residents from the northern Oregon coast (ODFW 2012).

The greater Tillamook Bay is also an important shellfish harvest area for both commercial and recreational fisheries. Mapped clam beds occur within the central bay and north of the study area. Common target species found in the bay include cockles, gaper clams, butter clams, softshell clams, and little neck clams. Tillamook Bay is also home to commercial oyster production. Recreational clam harvest totals in Tillamook Bay have been estimated by the Oregon Department of Fish and Wildlife to exceed 60,000 kilograms during the March through September harvest season (ODFW 2008b).

The study area and the surrounding waterways are used heavily by recreational boaters, including kayakers and stand up paddle board users. The rivers and streams adjacent to the project area are part of a National Recreational Water trail and are included in a series of guidebooks prepared by the Tillamook Estuary Partnership for the Tillamook Water Trails system. Public access points in and around the project area include a boat ramp at Ivy Avenue onto Hoquarten Slough, a boat ramp at Carnahan Park, and a boat ramp at Memaloose Point. The SFC study area is identified on bird watching sites as a good location to observe wetland species, and a hike that follows the existing roads and levees around the project area is described as the Goodspeed Road/Wilson-Trask Wetlands trail (Tillamook Birder 2015).

4.9.4.2 Environmental Consequences

This section discusses the potential effects of the action alternatives and the No Action Alternative on recreation activities and resources in the study area. Impacts related to recreation were evaluated for each of the project alternatives, with a focus on whether the alternatives would prevent access to recreation activities or reduce the quality of recreation activities by impacting study area aquatic habitats for fish, crabs, shellfish, birds, and other biota important to recreationists. There are no specific thresholds of significance with respect to recreation; therefore, potential impacts are described consistent with the impact evaluation criteria presented in **Table 4.1-1** such that moderate and major impacts would be considered significant. This evaluation considers the potential for impacts in the short term (construction period), transition period (re-vegetation period following construction), and the long term.

4.9.4.2.1 No Action Alternative

Construction, Transition Period, and Long Term

Under the No Action Alternative, existing conditions described above in the affected environment section would not change. Recreation access and activity levels in the study area under the No Action Alternative would not be expected to change. As described in Section 4.6.2, estuarine marshes support rearing of fish, shellfish, and crabs. The study area is currently inaccessible to many of those species or provides degraded habitat conditions. These degraded habitat conditions would not change under the No Action Alternative. The degraded habitat conditions of the study area are considered to have a moderate, local, impact on populations of recreational fish and shellfish that would be significant. There is some limited recreational access currently available on the SFC site, and this also would not change. The limited recreational access is a minor, local, beneficial effect.

4.9.4.2.2 Alternative 1: Southern Flow Corridor – Landowner Preferred Alternative

Construction

During construction of Alternative 1, impacts to recreation in the project area could result in the form of temporary closure of trails/access roads for safety reasons, given the presence of construction equipment. This short-term effect could impact bird watchers and hikers. The formal boat launches listed under the affected environment would not be affected during construction. Construction would not be anticipated to result in closure of adjacent waterways to recreational boating. The potential use of barges during construction would not affect recreational boating use around the project area. The availability of boat launches and recreational trails outside of the project area in the larger study area also would reduce the severity of this potential effect. The short-term effect of construction-related closures on recreation in the study area would be a minor, local, adverse impact that would be less than significant.

Construction-generated disturbances in the project area waterways from removal or replacement of tide gates, in-water work with any equipment, channel development, installation of sediment and turbidity controls, or other permanent or temporary in-water structures could, as was analyzed in Section 4.6.2, result in disturbances to aquatic habitat and temporarily impact area aquatic habitats. The BMPs and mitigation measures proposed in Section 6 would minimize the severity of these potential impacts. With implementation of these measures, construction of

Alternative 1 would be expected to have minor, local adverse impacts on recreational harvest of fish, crabs, and shellfish in the study area that would be less than significant.

Transition Period and Long Term

In the transition period and in the long term, no project-related impacts to recreation accessibility would be anticipated. Recreational access within the project area is currently limited to existing levees and roadways. The new levees would be open for walking and bird watching, and waterways in the project area would be accessible to shallow draft boats. Under the Proposed Action, the length of the levees and roads within the project area would be reduced by approximately 5.5 miles, but the length of shallow channels potentially accessible to boaters at high tides is expected to increase by over 14 miles. The existing approximately 4 mile loop walk described on bird watching sites would be lost. Levee areas periodically would be closed to access during maintenance activities, but this effect is expected to be temporary, minor, and less than significant. While the new setback levees would be much shorter than the existing levee system, it would still be possible to access the levees from the same point as the existing access point, and the range of species potentially visible to birders should be greater. The anticipated improvements in habitat quality and expansion of available estuarine habitat for aquatic species and birds in the study area would provide moderate to major beneficial effects for the recreational pursuits that depend on those species.

4.9.4.2.3 Alternative 2: Hall Slough Alternative

Construction

During construction of Alternative 2, impacts to recreation in the project area could result in the form of temporary closure of trails/access roads for safety reasons, given the presence of construction equipment. This short-term effect could impact bird watchers and hikers. Due to the availability of other recreational trails outside of the project area in the larger study area, this would be a minor, local, adverse impact that would be less than significant. The formal boat launches listed under the affected environment would not be affected during construction.

Under Alternative 2, Hall Slough would be dredged and widened. This work likely would be conducted from a barge or at least require construction equipment to be operating in the slough. This likely would result in the closure of Hall Slough to recreational boating during the construction period. The short-term effect of construction-related recreational access closures in the study area would be moderate for some users. However, the majority of the recreational users in the region access the larger waterways and the bay, which would not be affected by construction of Alternative 2. Therefore, the overall effect on recreational access during construction would be minor, local, and less than significant.

Construction-generated disturbances in Hall Slough would create temporary local impacts and could detrimentally affect local and migratory fish populations through temporary reductions in water quality from disturbance of soil and potential sedimentation. The Hall Slough Alternative would result in temporary impacts to fish habitat during construction and permanent impacts to this habitat from periodic channel maintenance. On the other hand, the Hall Slough Alternative would reconnect Hall Slough to the Wilson River, which could improve habitat for rearing and migrating salmonids over the long term. The BMPs and mitigation measures proposed in Section 6 would minimize the severity of potential adverse impacts. With implementation of these measures, construction of Alternative 2 would be expected to have minor, less than significant impacts on recreational fishing in the study area. Potential construction-related impacts on recreational use under Alternative 2 would be minor, local, and less than significant.

Transition Period and Long Term

In the transition period and in the long term, no project-related impacts to recreation accessibility would be anticipated, and the habitat quality for aquatic species and birds in the study area would be similar to the No Action Alternative, with the exception of the reconnection of Hall Slough, which could allow for the reestablishment of riverine flow-through wetlands along the slough's banks. Levee areas periodically would be closed to access during maintenance activities, but this moderate, adverse impact would be expected to be temporary, local, and less than significant.

4.9.4.2.4 Alternative 3: Southern Flow Corridor – Initial Alternative

Construction

During construction of Alternative 3, impacts to recreation in the project area would be the same as described for Alternative 1 and would be expected to result in minor, short-term effects on recreational access to the project area. Potential impacts on recreational use of adjacent waterways also would not be expected, and with implementation of BMPs and mitigation measures described in Section 6, there would be minor, local, adverse, less than significant impacts on fish, crabs, and shellfish in the study area under Alternative 3.

Transition Period and Long Term

Under alternative 3, existing access via levees and roads would be reduced by approximately 7 miles, but channels accessible to small boats at high tides are expected to increase by over 14 miles. In the transition period and in the long term, levee areas periodically would be closed to access during maintenance activities, but this minor effect is expected to be short term and less than significant. The anticipated improvements in habitat quality and expansion of available estuarine habitat for aquatic species and birds in the study area would provide moderate to major beneficial effects for the recreational pursuits that depend on those species. Because Alternative 3 would result in the restoration of more habitat than Alternative 1 (568 acres versus 522 acres), this beneficial effect would be slightly greater.

4.10 Unavoidable Adverse Environmental Effects

An EIS must include a discussion of any adverse environmental effects that cannot be avoided should the Proposed Action be implemented (40 CFR 1502.16). Unavoidable adverse effects are negative effects that remain after implementation of reasonable mitigation measures. The unavoidable adverse effects of the proposed and connected actions are summarized below. These effects are discussed in detail in other parts of this EIS.

4.10.1 Noise

Because the Tillamook Regional Medical Center (a sensitive receptor) parking lot abuts the project area boundary, noise levels from construction equipment working adjacent to the property boundary would generate an unavoidable adverse impact. However, the medical center buildings would be 350 to 450 feet from the closest noise sources, and predicted noise levels would be lower with increasing distance. This potential impact would be short term and intermittent.

4.10.2 Wetlands

Under the Proposed Action, there would be an unavoidable loss of freshwater wetlands, as the project area would be restored to tidal wetlands. Historically, wetlands in the Tillamook Bay area included tidal marshes, lower wooded tidelands, and river floodplain bottomlands. The wetlands in the study area have been modified by human activities and the separation from natural hydrologic and salinity regimes to the current predominance of freshwater wetlands. While the Proposed Action would affect the existing freshwater wetlands, it would restore the natural tidal wetlands that provide greater ecological functions in estuary and delta landscape settings such as are represented by the study area. Because there would be a net increase in wetland acres and functions, the impact on existing freshwater wetlands would not be significant.

4.10.3 Water Quality

Because of the amount of excess fill material that will be spread across the project area and subject to daily tidal inundation under the Proposed Action, there is a moderate potential for erosion to create adverse impacts on water quality through increased turbidity during the transition period. Turbidity could remain elevated for several years while the existing vegetation transitions to emergent tidal marsh communities.

4.10.4 Biological Resources

The Proposed Action would result in the removal of vegetation, including several hundred large spruce trees that currently grow on the levees that would be removed. In addition, some areas of forested and scrub-shrub vegetation would be lost as the natural hydrologic and salinity regimes are re-introduced. While the change from freshwater-based vegetation communities to the natural tidal wetland communities typically found in low-lying areas around the bay is not considered a significant adverse impact, there would be an unavoidable loss of freshwater wetland and riparian vegetation. The removal of mature spruce from levees along Hoquarten Slough in the southeastern portion of the project area where a spruce forest might be expected under unmodified conditions would result in moderate, local, adverse impacts on the area and function of this vegetation community. This temporal impact is not considered significant because of the small area affected and the expectation that spruce would be regrow in the same areas where they would be removed.

Although extensive mitigation measures would be implemented to protect fish and wildlife, some individuals inevitably would be harmed during construction. Construction noise and activity would be expected to displace wildlife that currently uses the site. Tree and shrub removal and grading (associated with the removal of old levees and construction of new levees) have the potential to impact nesting birds. With the conversion of existing habitat types to tidally influenced habitats, some terrestrial wildlife species and species dependent on freshwater aquatic habitats may not be able to reuse the project area following construction.

The removal of vegetation, heavy equipment operation, and in-water work all would have the potential to temporarily impact water quality in waters adjoining the project area, which could be detrimental to aquatic organisms in this area. In-water work, such as the filling of ditches and riprap removal below the high tide line, would require work area isolation and removal of fish from the work zone and has the potential for fish handling, which can result in inadvertent mortality of local and migratory fish and other aquatic organisms.

4.10.5 Visual Quality and Aesthetics

During construction, visual contrast would be unavoidably increased as levees and their associated vegetation is removed. This contrast would be visible from few viewpoints and would decrease over time as tidal wetlands become vegetated and blend with adjacent tidal habitats.

4.11 Irreversible or Irretrievable Commitment of Resources

An EIS must contain a discussion of any irreversible or irretrievable commitments of resources that would occur if the proposal were implemented (40 CFR 1502.16). Irreversible and irretrievable commitments of resources include alteration or destruction of a resource that cannot be replaced or restored and use of a resource that can only be used for one thing at a time. Because the action alternatives would not involve development of land, few irreversible or irretrievable commitments of resources would occur.

The equipment and labor involved in implementing the action alternatives would represent a temporary but irretrievable commitment of resources. Use of fuel in the equipment would be an irreversible commitment of a nonrenewable resource.

4.12 Relationship Between Short-Term Uses and Long-Term Productivity

An EIS must include a discussion of the relationship between the proposed project's short-term uses of the environment and maintenance and enhancement of the long-term productivity of the environment (40 CFR 1502.16).

The action alternatives would alter the landscape to varying degrees in the short term, resulting in areas of disturbed soil and loss of riparian and wetland vegetation. In the long term, the restoration of tidal hydrology and tidal wetlands would enhance long-term ecological productivity and benefit native species.

Although extensive mitigation measures would be implemented to protect wildlife during implementation of the selected alternative, some wildlife would inevitably be harmed. In the long term, conditions would improve for native wildlife, including coho salmon and designated critical habitat, through an increase in aquatic habitats, productivity, foraging, and refuge.

The short-term and long-term effects identified above are discussed in detail in other parts of this EIS.

SECTION 5 Cumulative Impacts

Cumulative effects analysis is an important element of the environmental documentation and approval process and is required by NEPA. Cumulative effects result from two or more effects that may be considered insignificant when analyzed separately but become significant when considered together. Cumulative effects analysis must take into consideration related past, present, and reasonably foreseeable future projects. The potential for cumulative effects from other flood hazard reduction and construction projects will be discussed in this section.

Past, present, and likely future projects were identified in consultation with POTB, Tillamook County, and the City of Tillamook. The local agencies have been evaluating and implementing flood hazard reduction projects in the Tillamook Valley for many years, including some that have been implemented in recent years. Projects were assessed for their potential to create cumulative effects, both positive and negative, on flood hazards and habitats in the valley.

Cumulative impacts of the Proposed Action are evaluated in combination with other flood hazard reduction projects as well as other general construction projects that may affect the same resources as those affected by the Proposed Action.

5.1 Identified Cumulative Actions

This analysis addresses actions in the recent past, the present, and the reasonably foreseeable future that could combine with the proposed and connected actions to cause a measurable impact. If measurable cumulative effects are identified, then an evaluation of whether those effects would be significant is made. FEMA considers reasonably foreseeable actions to be actions with a reasonable expectation of occurring, such as a project for which planning has begun or funding has been obligated. To identify reasonably foreseeable actions, information available from the applicant and other government agencies was reviewed.

Two reasonably foreseeable actions were identified: the Highway 101/OR 6 Traffic Improvement Project and dredging of Tillamook Bay, as described below. Most of the land within and near the study area is protected agricultural land, and other uses are not allowed. There are no foreseeable development projects that could have effects on the resources potentially affected by the alternatives under consideration. The sediments in the rivers and bay are silts and sands and would not be suitable for gravel extraction operations (a type of activity that could generate impacts on water quality and aquatic organisms).

5.1.1 The Highway 101/OR 6 Traffic Improvement Project

This project will entail roadway modifications to improve traffic performance and safety of Highway 101 and OR 6 through downtown Tillamook and across Hoquarten Slough (ODOT 2014). The project includes the following elements:

- Widen travel lanes and narrow the sidewalks by approximately 2 feet on Main and Pacific avenues between 1st and 4th streets

- Extend the existing Highway 101 couplet north from the existing Pacific Avenue/1st Street intersection to Hoquarten Slough
- Replace the existing three-lane bridge across Hoquarten Slough with a higher and wider four-lane bridge with bike lane and sidewalk improvements
- Reconstruct Highway 101 approximately 700 feet north of Hoquarten Slough to accommodate the new bridge
- Improve access to Hoquarten Interpretive Trail Park by constructing a new public street that also would provide access to adjacent private parcels
- Upgrade traffic signals at the intersections of 1st Street and Main Avenue, 1st Street and Pacific Avenue, 4th Street and Main Avenue, and 4th Street and Pacific Avenue.

Final design is currently ongoing, with construction of Phase 1, which includes building demolition and relocation of utilities, expected to begin in fall 2015. Phase 2 of the project will be constructed in stages, beginning with the east half of the new Highway 101 bridge over Hoquarten Slough. The construction sequence is provided below (ODOT 2015).

- Stage I – East Half of New Bridge and Approaches: Spring 2016 – Late Spring 2017
- Stage II – Summer Shutdown (No Traffic Impacts) – Summer 2017
- Stage III – West Half of New Bridge and Approaches – Fall 2017 – Late Spring 2018
- Stage IV – Final Paving and Cleanup – Summer 2018

An evaluation of potential impacts and proposed mitigation is provided in the Alternatives Analysis Report for the Highway 101/OR 6 Traffic Improvement Project (ODOT 2012), which was used to support this cumulative analysis.

5.1.2 Dredging of Tillamook Bay

The USACE Fiscal Year 2014 work plan for the Army Civil Works program included funding for maintenance dredging of the federal navigation channels used by Oregon’s small coastal ports, including Tillamook Bay and Bar (Garibaldi) (USACE 2014). This work was completed in February 2015. In addition, the County conducted a dredging project at the Memaloose Point boat launch that was completed in March 2015. There is no additional dredging work proposed at this time in Tillamook Bay or its tributary rivers. It is reasonably foreseeable that additional work would be needed in the future; however, it is unlikely additional work would be needed or funded for several more years.

5.2 Cumulative Impacts

The potential intensity and duration of cumulative impacts are taken into consideration when determining the magnitude of the cumulative impacts to each resource area. When possible, the assessment of effects on a resource is based on a quantitative analysis, but many impacts are difficult to quantify. In these cases, a qualitative assessment of cumulative impacts is made.

Cumulative impacts were evaluated utilizing the criteria and methodology identified for each resource area, discussed in Section 4, where the potential for an adverse impact, even a minor impact, was identified. These resource areas include Noise, Traffic, Water Resources (Floodplains, Wetlands, and Water Quality), Biological Resources (Vegetation, Fish and Wildlife, and Threatened and Endangered Species and Critical Habitat), Farmland Soils, Hazardous Materials, Visual Quality and Aesthetics, and Cultural Resources. The contribution to the cumulative condition for each resource area was considered for each alternative to determine the magnitude of potential cumulative impacts.

5.2.1 Noise

Construction of the action alternatives would generate moderate noise impacts in the short term during construction. Construction equipment on the Sadri parcel of the project area could produce noise levels that exceed significance thresholds at the neighboring sensitive receptor, the Tillamook Regional Medical Center.

Similarly, during construction of the Highway 101/OR 6 Traffic Improvement Project, noise impacts would occur. However, compared to existing conditions, none of the noise-receptor locations evaluated for the project would experience a substantial increase in noise levels over the long term (ODOT 2012). Dredging in Tillamook Bay would not be expected to result in noise impacts.

Although the medical center would experience significant adverse noise impacts from the Proposed Action, the other cumulative projects identified would not impact the medical center; therefore, there would be no cumulative impact from noise.

5.2.2 Traffic

Construction of the action alternatives would result in minor impacts to traffic due to the contribution of construction truck and worker trips to and from the project area on local roadways.

Construction of the Highway 101/OR 6 Traffic Improvement Project and dredging in Tillamook Bay would result in similar minor and less than significant changes in traffic congestion on study area roadways. Although the Highway 101/OR 6 Traffic Improvement Project would be constructed between 2015 and 2017, it would be shut down during the summer months when the SFC would be at its peak of construction activity. Therefore, there would not be an overlap in the construction-related traffic between the two projects. Because the SFC project would have only minor effects on traffic and would not result in a significant impact, there would not be a cumulative impact on traffic. Furthermore, traffic conditions are projected to improve in the study area following completion of the ODOT project when compared to existing conditions.

Because the projects would not overlap in time, implementation of the action alternatives in combination with the cumulative projects would generate no cumulative impacts related to traffic in the study area.

5.2.3 Water Resources

5.2.3.1 Floodplains

In the long term, the action alternatives would have beneficial effects on floodplains. However, the Proposed Action would indirectly include the construction of a parking lot for public recreational use within the floodplain near Hoquarten Slough. The beneficial effects of the Proposed Action would far outweigh the potential adverse effect of the parking lot.

The Highway 101/OR 6 Traffic Improvement Project would replace the bridge over Hoquarten Slough and also involve work in the floodplain. The new bridge would be wider, which could impact floodplain resources, but it would also be higher, which would provide beneficial effects on floodplain resources. In addition, remnant concrete pilings from a previous bridge structure in Hoquarten Slough would be removed, which would improve flow capacity in the Slough.

Although both projects would have some adverse effects on floodplains and they would occur close to each other in time and space (both on Hoquarten Slough), both projects would ultimately have beneficial effects on floodplains. Therefore, there would be a cumulative beneficial effect on floodplains.

5.2.3.2 Wetlands

Implementation of the action alternatives would have moderate, local, adverse effects on wetlands during construction and in the transition period, as existing wetlands would shift from freshwater to estuarine wetlands, as described in Section 4.5.2.3. However, over the long term, there would be a net increase in the acreage of wetlands, and historical wetland communities that provide greater functions and values in the estuary setting would be restored across the project area. Major, regional, beneficial effects would result from a major increase in wetland area and function and restoration of historical tidal wetlands.

No wetlands would be displaced or spanned by the Highway 101/OR 6 Traffic Improvement Project. Dredging in Tillamook Bay would not be expected to result in impacts to wetlands, as the navigation channel is deep and does not support wetlands.

Therefore, implementation of the action alternatives in combination with the cumulative projects would generate no cumulative impacts on wetlands.

5.2.3.3 Water Quality

Construction of the action alternatives would have moderate, short-term impacts on surface water due to the potential to impact water quality through increased turbidity. BMPs and mitigation measures would be implemented to reduce these impacts.

Construction of the Highway 101/OR 6 Traffic Improvement Project would result in a temporary increase in turbidity in Hoquarten Slough, which will also be minimized through implementation of BMPs. Permits for the proposed ODOT in-water work would require measures to limit and contain turbidity to a small area, and potential effects would be unlikely to extend to the SFC project area, which is approximately 800 feet from the Highway 101 bridge at its closest point. The ODOT project is expected to benefit surface water quality in the long term through the collection and treatment of stormwater containing potential contaminants from the roadway that currently discharges into the slough without treatment (ODOT 2012).

Dredging in Tillamook Bay would also result in temporary increases in turbidity. Any dredging would be required to be conducted under authorization of the CWA and ESA, and measures would be implemented during dredging to minimize turbidity to protect water quality and special-status species in Tillamook Bay. Turbidity from dredging would occur during the dredging work but would decline rapidly once the dredging stops. Therefore, impacts on water quality from dredging projects conducted in 2014 and 2015 would not be cumulative with work proposed in 2016.

Therefore, the action alternatives with implementation of BMPs and mitigation measures in combination with the cumulative projects would generate minor cumulative impacts on water quality. Cumulative impacts would be less than significant.

5.2.4 Biological Resources

5.2.4.1 Vegetation

Implementation of the action alternatives would have major impacts on vegetation. Existing vegetation that would be lost is predominantly planted pasture or non-native species. Approximately 100 to 150 spruce trees and all the red alder trees along Hoquarten Slough in the southeastern portion of the study area would be removed. Several hundred more spruce would be removed along Hall Slough as a result of the berm removal along Hall Slough in the northwestern portion of the study area under the Proposed Action and Alternative 3. Major beneficial effects would be expected to result from the long-term shift to a predominantly native, tidal wetland vegetation community. The Hall Slough Alternative would also result in short-term, adverse impacts with a long-term shift to more functional natural vegetation communities, resulting in moderate beneficial effects in the long term.

Construction of the Highway 101/OR 6 Traffic Improvement Project would impact a small amount of riparian vegetation around the bridge abutment. The vegetation around the existing bridge consists of a very narrow band of shrub and herbaceous vegetation with a few trees. The area is hemmed in on both sides by urban development and a developed park with maintained lawns. Areas disturbed by the ODOT project would be revegetated with native species (ODOT 2012). Impacts to vegetation would not be expected from dredging in Tillamook Bay, as the navigation channel is not known to support aquatic vegetation.

Over the long term, the action alternatives and the cumulative projects would have beneficial effects on vegetation communities. Therefore, implementation of the action alternatives in combination with the cumulative projects would generate no adverse cumulative impacts on vegetation.

5.2.4.2 Fish and Wildlife

Implementation of the action alternatives would adversely impact fish and wildlife in the short term during the construction phase. Moderate impacts would be associated with construction activities that would temporarily disrupt resident and migratory birds, disturb and displace aquatic organisms, and degrade water quality in rivers and other waterways in the study area. BMPs and mitigation measures as outlined in Section 6 would be implemented to avoid or reduce these temporary impacts. The Proposed Action and Alternative 3 would provide many benefits to fish and wildlife in the long term, including increased habitat complexity and availability, increased target species use, water quality enhancement, and increased climate change resilience. The Hall Slough Alternative would also provide beneficial effects compared to the existing condition although they would be of a lesser magnitude as compared to the other two action alternatives.

Construction of the Highway 101/OR 6 Traffic Improvement Project would result in impacts on fish and wildlife that also would be minimized through the implementation of mitigation measures. In the long term, the project is expected to increase habitat quality and water quality of Hoquarten Slough (ODOT 2012). Although the highway project would include some in-water work and construction of a center bridge support pier, the work would include measures to minimize potential impacts on aquatic species from turbidity and noise. In addition, the work is separated in space from the proposed work that would take place on Hoquarten Slough under Alternatives 1 and 3; therefore, there would not be cumulative effects. Dredging in Tillamook Bay would have the potential for adverse effects on fish and other aquatic species from temporary increases in turbidity. Both the ODOT Highway 101 project and any dredging would be required to be conducted under authorization of the CWA and ESA, and measures would be implemented during dredging to minimize turbidity to protect water quality and special-status species in Tillamook Bay.

The Highway 101 bridge replacement would remove a small amount of riparian vegetation. The vegetation around the existing bridge consists of a very narrow band of shrub and herbaceous vegetation with a few trees. The area is hemmed in on both sides by urban development and a developed park with maintained lawns. There would be little use of the area by terrestrial wildlife. Because the work would be conducted largely in the fall and early spring, there would be little potential for impacts on migratory birds. Therefore, although the SFC project would have a moderate adverse impact on wildlife during construction, there would not be cumulative effects with the Highway 101 bridge replacement project.

Implementation of the action alternatives in combination with the cumulative projects could result in short-term, adverse, cumulative impacts. With the implementation of BMPs and appropriate mitigation measures, these impacts would not be significant. In the long term, the cumulative effect of the action alternatives and the Highway 101/OR 6 Traffic Improvement Project would be cumulatively beneficial to fish and wildlife.

5.2.4.3 Threatened and Endangered Species and Critical Habitat

NOAA and USFWS have determined that implementation of the Proposed Action would have moderate, short-term, adverse impacts on federally threatened Oregon Coast Coho salmon and Marbled murrelet, respectively. Impacts would be associated with disturbing aquatic habitats and water quality for coho and removal of potential nesting trees for Marbled murrelet. Impacts would be reduced through implementation of BMPs and mitigation measures, including work area isolation, erosion control BMPs, and in-water work timing. All project activities that have the potential to impact aquatic habitats would adhere to design criteria and minimization standards to limit impacts to listed coho, designated critical habitat, green sturgeon, and EFH as outlined in PROJECTS (NMFS 2013a). USFWS is the lead agency for the review of cumulative impacts on Marbled murrelets and has determined there would not be cumulative impacts on the species from the SFC project.

In the long term, the Proposed Action would result in a net increase in aquatic habitats, increased productivity of coho salmon, and benefits to designated critical habitat for coho salmon through expansion and improvement of habitat connectivity, availability, and quality. The action alternatives would have moderate, regional, long-term benefits to Marbled murrelet foraging habitat.

Construction of the Highway 101/OR 6 Traffic Improvement Project would have moderate, localized, adverse effects on coho salmon and green sturgeon from pile driving, demolition, temporary increased turbidity, and stormwater discharges despite proposed conservation measures. The ODOT project is not likely to adversely affect designated critical habitat for coho salmon and green sturgeon (ODOT 2012). Dredging in Tillamook Bay also would have the potential for moderate, local, adverse effects on these species from temporary localized increases in turbidity. Both the project on Highway 101 and any dredging in Tillamook Bay would be required to be conducted under authorization of the CWA and ESA, and measures would be implemented during in-water work to minimize turbidity to protect water quality and special-status species in Tillamook Bay. Both the highway project and dredging in Tillamook Bay would have no effect on Marbled murrelet.

Therefore, implementation of the action alternatives in combination with the cumulative projects could generate significant and unavoidable short-term, temporary, adverse cumulative impacts on threatened and endangered species. However, as noted above, in the long term, both the Proposed Action and the Highway 101/OR 6 project would result in a net increase in aquatic habitats and improvements in conditions for coho salmon over the long term.

5.2.5 Farmland Soils

Construction of the action alternatives would have minor impacts on farmland soils due to indirect conversion of farmland of statewide importance. The action alternatives would be in compliance with the FPPA.

Neither the Highway 101/OR 6 Traffic Improvement Project nor dredging in Tillamook Bay would result in loss or conversion of farmland soils.

Therefore, implementation of the action alternatives in combination with the cumulative projects would generate no cumulative impacts related to loss or conversion of farmland soils.

5.2.6 Hazardous Materials

Construction of the action alternatives could result in moderate, adverse impacts related to the accidental release of hazardous materials used during construction. With implementation of BMPs described in Section 6 and compliance with applicable regulations, this would be a minor potential impact. The Proposed Action and Alternative 3 would both include the cleanup of contaminated materials at the Sadri property. This cleanup would result in beneficial effects on the environment from implementation of either of these two alternatives. This area would not be cleaned up under the Hall Slough Alternative, and this source of contamination would continue to impact the environment.

Construction of the Highway 101/OR 6 Traffic Improvement Project could encounter hazardous materials at several properties located along Highway 101 where historical releases have occurred (ODOT 2012) if excavation is proposed that would expose contaminated materials. BMPs and mitigation measures would be required to reduce the potential for impacts and to prevent the release of hazardous materials during construction. Similarly, during dredging in Tillamook Bay, BMPs would be required by the CWA permits to prevent the release of hazardous materials from dredging equipment.

Therefore, with implementation of the mitigation measures described in Section 6, the action alternatives, in combination with the cumulative projects, would generate minor, adverse, cumulative impacts related to hazardous materials. Cumulative impacts would be less than significant.

5.2.7 Visual Quality and Aesthetics

Construction of the action alternatives could result in moderate to major short-term impacts on visual quality and aesthetics with the placement of construction equipment in the project area and the disturbance of earth and removal of vegetation. These significant impacts would be expected to continue into the transition period as vegetation reestablishes. In the long term, the visual characteristics of the project area would become more consistent with the surrounding landscape.

During construction of the Highway 101/OR 6 Traffic Improvement Project, there would be short term and transition period visual impacts similar to the action alternatives because riparian vegetation would be removed and would take some time to regrow, and the bridge would have a different appearance than the existing bridge. In the long term, visual quality and aesthetics of the slough environment after construction would not change adversely from the current views (ODOT 2012). Dredging projects in the bay would have no long-term effect on visual quality and aesthetics.

Therefore, implementation of the action alternatives in combination with the cumulative projects could generate adverse, cumulative impacts during construction and for a transition period until shrub vegetation is re-established on visual quality and aesthetics. There would be minor to moderate long-term, adverse impacts on visual quality and aesthetics. Cumulative impacts would be less than significant.

5.2.8 Cultural Resources

Construction of the action alternatives could result in minor, local, adverse impacts due to a low potential to encounter cultural resources during construction. With implementation of mitigation measures, these potential impacts would be less than significant. Mitigation measures described in Section 6 would further reduce the potential for adverse impacts.

Construction of the Highway 101/OR 6 Traffic Improvement Project would have no impact on historic properties or cultural resources (ODOT 2012). Dredging in Tillamook Bay would not be expected to result in impacts on cultural resources.

Therefore, implementation of the action alternatives in combination with the cumulative projects would not generate cumulative impacts related to cultural resources.

SECTION 6 Mitigation

This section describes the mitigation measures that would be required during implementation of any of the action alternatives (the Proposed Action, the Hall Slough Alternative, or the SFC – Initial Alternative). Measures are required to avoid and/or reduce the potential impacts described in this EIS such that they would not be significant. Many of the measures related to protection of water quality through management of potential erosion and handling of hazardous materials are standard BMPs that construction contractors should routinely implement. Because the action alternatives all involve considerable in-water work, the potential for turbidity from erosion or hazardous materials to have a major impact if not handled appropriately is high. Therefore, these standard BMPs are listed here and in Appendices G and J and would be implemented by the applicant as a condition of local, state, and federal permit authorizations.

The PROJECTS programmatic biological opinion (NMFS 2013a) would be applied to the Proposed Action and Alternative 3 (see Appendix G and http://www.habitat.noaa.gov/pdf/2013_12-03_PROJECTS_NWR-2013-10221.pdf). PROJECTS contains many mitigation measures to protect threatened and endangered species and their habitats while conducting restoration, levee setback and removal, and tide/flood gate removal, replacement, or retrofit projects. The measures relevant to the action alternatives are included in the list below. However, natural resources agencies would determine the adequacy of proposed mitigation, and supplemental mitigation may be required. In addition, the Hall Slough Alternative would require supplemental mitigation measures (see Bullet 13 below) due to the widening and deepening of Hall Slough and maintenance dredging, which are not covered by PROJECTS.

Potential impacts that could be significant and required mitigation are described below.

1. <u>Coho Salmon</u> – All action alternatives have the potential to impact aquatic habitats, including critical habitat for coho salmon and designated EFH. The following mitigation would be implemented to reduce this potential impact:

    - All project activities must adhere to a variety of design criteria and minimization measures as outlined in PROJECTS guidelines. These guidelines apply to setback or removal of existing berms, dikes, and levees; tide/flood gate removal, replacement, or retrofit; the use and operation of heavy equipment; erosion control; general project design; invasive species control; fish passage and fish capture and removal (salvage); and other project design components.

    - Mitigation measures described under Bullets 3, 4, and 5 that mitigate potential effects on fish and aquatic habitats also would provide mitigation for potential effects on coho and EFH.

2. <u>Harbor Seals and Other Marine Mammals</u> – All action alternatives have potential to alter behavior of these species. The following mitigation would be implemented to reduce this potential impact.

- The use of heavy equipment on levees or other over-water structures will be restricted when marine mammals are within 100 yards of the work area. Work being completed on the landward side of the levee may proceed. Construction crews will be educated on how to identify harbor seals prior to work on the levees.

3. Fish and Other Aquatic Species – All action alternatives have the potential to harm fish and other aquatic species during in-water construction activities. The following mitigation would be implemented to reduce this potential impact:

- All in-water work associated with project construction must occur during the ODFW preferred in-water work window (ODFW 2008a), including any approved variance to the established window.

- Adhere to design criteria and impact minimization measures outlined in PROJECTS for protection of eulachon, green sturgeon, EFH, and designated aquatic critical habitat.

- Mitigation measures described under Bullets 4, 5, and 12 also would be required to mitigate potential effects on fish and aquatic habitats.

- Work area isolation of waterways from construction activities will include the deployment of silt curtains or other appropriate measures.

4. Fish Passage – All action alternatives have the potential to block or alter the movement of fish and other aquatic species. The following mitigation would be implemented to reduce this potential impact:

- In compliance with PROJECTS (NMFS 2013a), provide fish passage for any adult or juvenile ESA-listed fish likely to be present in the action area during construction unless passage did not exist before construction, stream isolation and dewatering is required during project implementation, or the stream is naturally impassable at the time of construction. After construction, provide fish passage that meets NMFS' fish passage criteria for any adult or juvenile ESA-listed fish (NMFS 2011) for the life of the action.

- All activities that include installation or replacement of over water structures, including temporary or permanent bridges, tide gates, culverts, or fishways, require an ODFW approved fish passage plan (ODFW 2014c).

- In accordance with PROJECTS, tide gate designs must also be reviewed and approved by an NMFS fish passage engineer. To comply with design requirements established by PROJECTS, new tide gates may be required to be "fish friendly." Fish friendly tide gates have a prolonged open period that minimizes the blockage of fish passage while maintaining tide gate functionality aimed at minimizing high tide intrusion or backwater containment. This increases opportunities for juvenile fish to enter favorable backwater habitats at high tide but reduces opportunities for stranding during low tide conditions.

5. Fish Salvage – All action alternatives have the potential to result in harm to fish from stranding. The following mitigation from PROJECTS would be implemented to reduce this potential impact:

- If practicable, allow listed fish species to migrate out of the work area or remove fish before dewatering; otherwise remove fish from an exclusion area as it is slowly dewatered with methods such as hand or dip-nets, seining, or trapping with minnow traps (or gee-minnow traps).
- Fish capture will be supervised by a qualified fisheries biologist with experience in work area isolation and competent to ensure the safe handling of fish.
- Conduct fish capture activities during periods of the day with the coolest air and water temperatures possible, normally early in the morning, to minimize stress and injury of species present.
- Monitor the nets frequently enough to ensure they stay secured to the banks and free of organic accumulation.
- Electrofishing will be used during the coolest time of day and only after other means of fish capture are determined to be not feasible or ineffective.
    a. Follow the most recent version of NMFS (2000) electrofishing guidelines.
    b. Do not electrofish when the water appears turbid, e.g., when objects are not visible at depth of 12 inches.
    c. Do not intentionally contact fish with the anode.
    d. Use direct current or pulsed direct current within the following ranges:
        1. If conductivity is less than 100 microsiemens (µs), use 900 to 1100 volts.
        2. If conductivity is between 100 and 300 µs, use 500 to 800 volts.
        3. If conductivity greater than 300 µs, use less than 400 volts.
    e. Begin electrofishing with a minimum pulse width and recommended voltage then gradually increase to the point where fish are immobilized.
    f. Immediately discontinue electrofishing if fish are killed or injured, i.e., dark bands visible on the body, spinal deformations, significant de-scaling, torpid, or inability to maintain upright attitude after sufficient recovery time. Recheck machine settings, water temperature, and conductivity and adjust or postpone procedures as necessary to reduce injuries.
- If buckets are used to transport fish:
    a. Minimize the time fish are in a transport bucket.
    b. Keep buckets in shaded areas or, if no shade is available, covered by a canopy.
    c. Limit the number of fish within a bucket; fish will be of relatively comparable size to minimize predation.

d. Use aerators or replace the water in the buckets at least every 15 minutes with cold clear water.

e. Release fish in an area upstream with adequate cover and flow refuge; downstream is acceptable provided the release site is below the influence of construction.

f. Be careful to avoid mortality counting errors.

g. Monitor and record fish presence, handling, and injury during all phases of fish capture, and submit a fish salvage report to NMFS within 60 days of capture, documenting date, time of day, fish handling procedures, air and water temperatures, and total numbers of each salmon, steelhead, and eulachon handled and numbers of ESA-listed fish injured or killed.

6. Marbled Murrelet – Construction of the action alternatives has the potential to disrupt or disturb nesting Marbled murrelets and nest success. The biological assessment (BA) (USFWS 2015c), outlines the mitigation measures described below. However, it may not be possible to follow the standard seasonal and daily timing restrictions on the use of heavy equipment in proximity to potential murrelet usage areas. USFWS is considering the benefit of allowing the construction to be completed over one nesting season with increased potential disturbance for that one year as compared to requiring construction to be conducted over several nesting seasons. Through the ESA consultation process, additional or alternate mitigation and minimization provisions may be required in the biological opinion that would need to be incorporated into the project design and implementation.

- Individual tree removal will not include the loss of occupied or unsurveyed nesting structure during the breeding period. If a tree with nesting structure in an occupied or unsurveyed stand will be removed to achieve tidal wetland habitat restoration goals, it will be done prior to April 1 or after September 15.

- Activities associated with use of heavy equipment to complete the project actions (including site preparation, clearing, levee removal, channel creation, and ditch filling) will be avoided within the disruption distance of known occupied or unsurveyed suitable murrelet habitat or unsurveyed nesting structure from April 1 to June 15. Use of Goodspeed Road within unsurveyed suitable murrelet habitat for equipment transport and haul will be allowed during the period April 1 to June 15, subject to the following restrictions:

    - Road use shall be limited to 2 hours after sunrise to 2 hours before sunset. After June 15, activities in these areas would have no daily timing restriction due to the difficulty of implementing a multi-phase habitat restoration construction project in tidally influenced areas. The June 15 end date for daily timing restrictions would increase the potential for all project phases to be completed in one construction season, which would reduce the overall temporal impact of the project.

- Use of helicopters within the disruption distance of occupied murrelet habitat, unsurveyed suitable murrelet habitat, and unsurveyed murrelet nesting structure during the entire breeding period (April 1-September 15) will not be allowed.
- Activities associated with use of heavy equipment to complete the project actions, including site preparation, clearing, levee removal, channel creation, and ditch filling, would abide by a daily timing restriction between April 1 and June 15. During this period, work would not begin until 2 hours after sunrise and would end 2 hours before sunset.

7. Bald Eagle – Alternatives 1 and 3 have the potential to disturb nesting Bald eagles. The following mitigation would be implemented to reduce this potential impact:

    - In compliance with the Bald and Golden Eagle Protection Act, all trees containing active or relict eagle nests should be retained, and activities that may disrupt nesting activities, if active nesting occurs within 660 feet of construction activities, should be avoided. If removal or disturbance of a nest tree is unavoidable or if vegetation within 660 feet of a nest would be permanently altered, the applicants will coordinate with USFWS to develop appropriate mitigation measures and obtain the necessary permits.

8. Migratory Birds – All action alternatives have the potential to disturb nesting migratory birds. The following mitigation would be implemented to reduce this potential impact:

    - To comply with the Migratory Bird Treaty Act, all project activities that have the potential to disturb or remove woody vegetation or include substantial removal of herbaceous vegetation during grubbing and clearing should be conducted outside of active nesting periods for migratory birds as much as practicable. Minimization of impacts to nesting birds includes timing of vegetation removal based on species and location. Vegetation removal will be scheduled for the period with lowest likelihood of encountering nesting birds to the greatest extent practicable, which is September 1 to March 1. This is in addition to the avoidance and minimization measures related to vegetation clearing for Bald eagles (Bullet #7) and Marbled murrelets (Bullet #6). An avian protection plan would be developed and implemented to minimize potential impacts on nesting native birds.

9. Terrestrial Wildlife – All action alternatives have the potential to harm common terrestrial wildlife during construction. The following mitigation would be implemented to reduce this potential impact:

    - Project-related vehicles would observe a 15 mile-per-hour speed limit in all project areas, except on City or County roads and state and federal highways. Off-road traffic outside of designated project areas would be prohibited.
    - To avoid and/or minimize attracting predators to the site, all food-related trash items, such as wrappers, cans, bottles, and food scraps, would be disposed of in a securely covered container. These containers would be emptied and debris removed from the project site at the end of each working day.

10. Wetlands – All action alternatives have the potential to impact wetlands. All of the alternatives also would result in more wetland acreage and improved wetland functions following construction. Therefore, the alternatives would be considered to be self-mitigating. Mitigation measures to control erosion and sedimentation (Bullet 12) would be required to prevent degradation of wetlands not directly affected by construction.

11. Vegetation – All action alternatives would have short-term temporary impacts to vegetation within construction areas. The following mitigation measures would be implemented to reduce this potential impact:

    - Clearing limits would be clearly marked.
    - The removal of existing vegetation would be minimized. The existing pasture and hayfield vegetation along the Trask River would be protected to function as a vegetated filter strip until increased salinity from restoration naturally results in a change in this vegetation.
    - To ensure non-native or invasive plants or seeds are not introduced or spread in the project area, wash soil and plant material off all equipment tires and treads before moving from one area to another (or moving to and from the staging area to the work area). Vehicle wash stations would be located at strategic construction site exits determined by the contractor in compliance with federal and state permit conditions.
    - Consistent with PROJECTS (NMFS 2013a), the following measures would be implemented:

        a. Whenever reasonable, use existing access roads and paths preferentially. Vehicular traffic would be limited to haul roads and existing disturbed areas to the extent possible.

        b. Minimize the number and length of temporary access roads and paths through riparian areas and floodplains.

        c. When it is necessary to remove vegetation, cut at ground level (no grubbing) whenever practicable to meet project purposes.

        d. Do not build temporary access roads or paths where grade, soil, or other features suggest slope instability.

        e. After construction is complete, obliterate all temporary access roads and paths, stabilize the soil, and revegetate the area.

        f. Temporary roads and paths in wet areas or areas prone to flooding will be obliterated by the end of the in-water work window. Decompact road surfaces and drainage areas, pull fill material onto the running surface, and reshape to match the original contours.

12. Soil Erosion and Sedimentation – Construction activities associated with the action alternatives, including levee removal and modification, grading, temporary road development and use, tree removal, clearing and grubbing, and installation of in-water structures, have the

potential to discharge sediment or other construction-related pollutants to area waterways. The following mitigation measures would be implemented to reduce this potential impact.

In compliance with PROJECTS (NMFS 2013a), the following measures would be implemented:

- Use site planning and site erosion control measures commensurate with the scope of the project to prevent erosion and sediment discharge from the project site.
- Before significant earthwork begins, install appropriate, temporary erosion controls downslope to prevent sediment deposition in the riparian area, wetlands, or waterbody.
- During construction, if eroded sediment appears likely to be deposited in the stream during construction, install additional sediment barriers as necessary.
- Temporary erosion control measures may include fiber wattles, silt fences, jute matting, wood fiber mulch and soil binder, or geotextiles and geosynthetic fabric.
- Soil stabilization utilizing wood fiber mulch and tackifier (hydro-applied) may be used to reduce erosion of bare soil if the materials are noxious weed free and nontoxic to aquatic and terrestrial animals, soil microorganisms, and vegetation.
- Remove sediment from erosion controls if it reaches 1/3 of the exposed height of the control.
- Whenever surface water is present, maintain a supply of sediment control materials and an oil-absorbing floating boom at the project site.
- Stabilize all disturbed soils following any break in work unless construction will resume within 4 days.
- Remove temporary erosion controls after construction is complete and the site is fully stabilized.

Additional mitigation measures for erosion control would include:

- Stabilized construction entrances would be installed to minimize transport of soil onto public streets. The number of construction exits would be minimized to the extent practicable. A shaker rack or rumble rack would be used to remove mud from truck tires, especially during wet weather.
- Plastic sheeting would be used to cover exposed stockpiles. Construction staging areas would be located where eroded material has a reasonable chance of containment before reaching the stream network. Upon completion of construction, all staging and stockpile areas would be decompacted and revegetated.
- Perimeter levees would be removed in phases to limit unnecessary erosion of soils.
- Berm removal would not occur during high tides.

- Construction will rely on proper sequencing to minimize the amount of in-water work performed.
- For in-water work in ditches on the floodplain, work area isolation dams would be used to prevent flow from ditches entering the main drainage network. Fish would be removed from isolated work areas following the protocols described in Bullet 5. Floating silt curtains may be used in lieu of work area isolation dams in areas without deep water or high flow velocities; floating silt curtains would be used, where possible, to isolate work areas.
- The duration of in-water work would be minimized to reduce exposure of unstable soil.
- Organic geotextiles, erosion control blankets, or other biodegradable matting would cover newly exposed banks and levees to temporarily reduce erosion, encourage reestablishment of natural vegetative cover, and improve in-channel habitat.
- Soil stabilizing measures would be placed in newly exposed areas where tide gates would be removed to minimize sediment impacts.
- The exposed top surface of levees would be graded towards the interior to prevent direct runoff to the rivers.
- Hydroseeding using appropriate plant species would be used for temporary and permanent seeding of bare surfaces previously occupied by ditches that are filled or levees that are modified or removed.
- Sequencing of work will be planned to prevent tidal flows entering areas until restoration work is completed. Also, sequence and schedule work to reduce the exposure of bare soil to wind erosion.
- Compost and/or brush berms at the clearing limits would be used where sediment transport into nearby waterways is possible. Brush and small trees removed for construction would be reused for this purpose as practicable.
- Brush and small trees removed from parts of the project would be chipped for mulch, and spread over disturbed areas where low water velocities would be expected.
- Slightly convex surfaces would be created over ditches to shed water. If possible, topography would be shaped in ways that encourage the formation of a more natural drainage network.
- Turbidity in waterways during in-water construction activities shall be monitored, and temporary increases would conform to the limits allowed by the Section 401 water quality certification permit.
- Measures described in Bullet 11 also would provide protection against erosion and sedimentation.
- Dry exposed soils would be watered to limit wind erosion of dry surfaces, limiting fine sediment dispersal.

- Implement the dust abatement measures described in Bullet 17.
- Inspect erosion and sediment control measures at the end of each work day.

13. Dredging – Dredging during construction of and maintenance for the Hall Slough Alternative has the potential to result in adverse impacts to water quality, fish, and other aquatic organisms. The following mitigation would be implemented to reduce this potential impact:

    - Use of a clamshell dredge using a close-lipped bucket (also referred to as an "environmental" bucket) operated from shore or a floating crane. This bucket has flaps that close off the top of the bucket during ascent, which reduces sediment re-suspension into the water column. An open bucket will only be used on a limited basis if sediments cannot be effectively removed with a close-lipped, environmental bucket.
    - Modify the bucket speed, ensure the bucket is closed before ascent, maintain the bucket flaps, fill the bucket to capacity to minimize water in the bucket, prevent overfilling the bucket, and modify the bucket size and/or type.
    - Post-dredge bathymetric surveys will be conducted to verify only the material identified to be dredged was removed to the proper, authorized depth.
    - A bin-barge or flat-deck barge with tall, watertight sideboards will be used to enclose dredged material, including dredged sediment and water. No material will be allowed to leak from the bins or overtop the walls.
    - The barge will be loaded so that enough of the freeboard remains to allow for safe movement of the barge and its material on its planned route to the approved placement facility.
    - All equipment used for in-water work will be clean and inspected daily prior to use to ensure the equipment has no fluid leaks. Should a leak develop during use, the leaking equipment will be removed from the project site immediately and not used again until it has been adequately repaired. At no time will fuels or oils be allowed to enter the river.
    - Floating spill containment booms and absorbent booms will be maintained on board dredge and disposal equipment to facilitate the cleanup of hazardous material spills. Containment booms and/or absorbent booms will be installed in instances where there is a potential for release of petroleum or other toxic substances.
    - A monitoring plan will be implemented to monitor for turbidity during each dredging event and to help ensure the water quality will be adequately protected. Monitoring will be conducted at locations upstream (background) and downstream from the point of discharge.

14. Hazardous Materials – Construction of the action alternatives has the potential to encounter hazardous materials in soil and/or groundwater or to result in the accidental release of construction-related hazardous materials. The following mitigation would be implemented to reduce this potential impact:

- A CMMP would be implemented during construction within areas of known or suspected contamination, including the Sadri property. Contaminated soil would be managed in compliance with federal and state laws and regulations. The CMMP would describe the proposed measures for protection of human health and the environment during soil excavation and placement for disposal.
- Site preparation, construction, and capping of areas of contaminated soil to be contained within the project area would be engineered such that the mobility of contaminants in the fill material is controlled. The concentrations of contaminants in the resulting “leave” surface (i.e., the exposed, residual soils left on the finished ground surface following construction) must not exceed screening levels for ecological receptors.
- Vehicle and heavy equipment refueling and maintenance would only be permitted in designated disturbed/developed areas where accidental spills can be immediately contained (as described below). All project-related heavy equipment would be maintained regularly to avoid fluid leaks (e.g., gasoline, diesel fuel, hydraulic fluid). All leaking fluid would be stopped or captured in a container until such time the equipment can be immediately moved off site and repaired. Storage of hazardous materials would not occur within 500 feet of any surface waters. A plan would be prepared for immediate containment and cleanup of hazardous material spills within or adjacent to each site.
- A worker health and safety plan (per 29 CFR 1926.35) would be prepared and implemented prior to the start of construction activities. All workers will be required to review and sign the plan prior to starting work. The health and safety plan should, at a minimum, identify the following:
    a. All contaminants that could be encountered during excavation activities
    b. All appropriate worker, public health, and environmental protection equipment and procedures
    c. Emergency response procedures
    d. Most direct route to a hospital
    e. Site safety officer
- Proposed design criteria established in PROJECTS would be applied for protection of aquatic life from hazardous materials. These include the following general construction measures for preventing the release of contaminants to surface waters.
    a. Designate and use staging areas to store hazardous materials or to store, fuel, or service heavy equipment, vehicles, and other power equipment with tanks larger than 5 gallons that are at least 500 feet from any natural waterbody or wetland or on an established paved area such that sediment and other contaminants from the staging area cannot be deposited in the floodplain or stream.

b. Post written procedures for notifying environmental response agencies, including an inventory and description of all hazardous materials present and the storage and handling procedures for their use.

c. Maintain a spill containment kit, with supplies and instructions for cleanup and disposal, adequate for the types and quantity of hazardous materials present.

d. Train workers in spill containment procedures, including the location and use of the spill containment kits.

e. Temporarily contain any waste liquids generated under an impervious cover, such as a tarpaulin, in the staging area until the wastes can be properly transported to, and disposed of, at an approved receiving facility.

f. Before entering wetlands or working within 150 feet of a waterbody, replace all petroleum-based hydraulic fluids with biodegradable products.

g. Inspect all equipment, vehicles, and power tools for fluid leaks before they leave the staging area.

h. Before operation within 150 feet of any waterbody, and as often as necessary during operation, thoroughly clean all equipment, vehicles, and power tools to keep them free of external fluids and grease and to prevent leaks and spills from entering the water.

i. Generators, cranes, or other stationary heavy equipment operated within 150 feet of any waterbody will be maintained and protected as necessary to prevent leaks and spills from entering the water.

15. <u>Cultural Resources</u> – Excavation of material around the mill sites on the Sadri parcel have the potential to encounter archaeological objects. An archaeological monitor will be on site during excavation, and if archaeological objects are encountered, the archaeological inadvertent discovery plan will be implemented.

16. <u>Public Health and Safety</u> – Construction of the action alternatives has the potential to endanger public health and safety during construction. The following BMPs would be implemented during construction to avoid or reduce potential impacts to public health and safety:

- Public notification of the location and duration of construction activities, including pedestrian/trail closures and restrictions on boating, fishing, and other recreational use of the project area.

- Verification with local jurisdictions that construction use of existing roadways will not interfere with existing emergency evacuation plans.

- Adequate signage regarding the location of construction sites and warning of the presence of construction equipment.

- Fencing of construction staging areas and of construction areas if dangerous conditions exist when construction is not occurring.

- Temporary walkways and bike paths where an existing sidewalk or pedestrian/bicycle path/trail will be closed during construction. Appropriate markings, barriers, and signage would be used to create a safe separation between recreational visitors and pedestrians and vehicular traffic.

17. Dust Abatement – Construction of the action alternatives has the potential to generate nuisance dust. The following mitigation would be implemented to reduce this impact:

    - Employ dust abatement measures commensurate with soil type, equipment use, wind conditions, and the effects of other erosion control measures.

    - Sequence and schedule work to reduce the exposure of bare soil to wind erosion.

    - Maintain spill containment supplies on site whenever dust abatement chemicals are applied.

    - Do not use petroleum-based products.

    - Do not apply dust-abatement chemicals, e.g., magnesium chloride, calcium chloride salts, ligninsulfonate, within 25 feet of a waterbody or in other areas where they may run off into a wetland or waterbody.

    - Do not apply ligninsulfonate at rates exceeding 0.5 gallons per square yard of road surface, assuming a 50:50 solution of ligninsulfonate to water.

SECTION 7 Agency Coordination, Public Involvement, and Permits

This section documents the consultation and coordination activities that have occurred prior to and during the development of this Draft EIS. This section states where the Draft EIS can be viewed and provides information about how recipients received copies of the Draft EIS or a notice of its availability.

7.1 Public Involvement

Public involvement is an essential component of the environmental compliance process. NEPA requires public participation during the preparation of an EIS. The following sections describe the public involvement opportunities that have occurred and will occur for this EIS. Scoping activities conducted prior to the development of this Draft EIS are also described in the Scoping Report in Appendix B.

7.1.1 Early Scoping Activities

Public involvement on this project has been ongoing since 2000 when USACE conducted public scoping meetings for a proposed EIS on flood damage reduction and ecosystem restoration alternatives in the Tillamook Valley. Prior public involvement activities also included the extensive outreach conducted as a part of the Oregon Solutions Project. Initiated in 2007 through the establishment of a Project Team and a Design Committee of 37 governmental agencies, non-profit organizations, and local business interests, the Oregon Solutions Project Team met regularly to identify and evaluate potential solutions to flooding in Tillamook Valley.

To support this outreach effort, the Oregon Solutions Project Team utilized extensive contact lists to notify and invite interested stakeholders to each meeting. Meeting notices were also further disseminated to interested persons through stakeholder contact lists maintained by each member organization. The TBHEID played an important role in this notification effort with its outreach to its member residents and agricultural and commercial interests.

In addition to the Oregon Solutions Project meetings, all Oregon Solutions contract matters, including the hiring of consultants, receipt of consultant briefings on study outcomes, construction contracts, and land purchases, were open to review by the public. Notice of all meetings of the County Board of Commissioners is provided to the public and published on the County's website. Meeting proceedings are recorded for rebroadcast on the local public access television channel.

7.1.2 Public Scoping

FEMA published an NOI to prepare an EIS in the *Federal Register* on May 6, 2014. The NOI included a description of the project purpose and need and the alternatives and invited the public to attend a public meeting and submit comments on the project. FEMA hosted a public scoping meeting on May 28, 2014, at the POTB Officer's Mess Hall in Tillamook, Oregon. Written comments were received at the meeting. FEMA also accepted written comments through mail, email, posted on the FEMA SFC EIS website, and by fax throughout the 30-day scoping period from May 14, 2014 to June 13, 2014. Approximately 29 public comments and 9 comments from agencies were received by mail, email, comment card, fax, and verbal comment. A scoping report, summarizing all comments received through July 2014, was published in August 2014. Appendix B contains a copy of the scoping report, including comments received. The scoping report is also available on the project website at http://southernfloweis.org.

7.1.3 Public Comment on the Draft EIS

FEMA has published a Notice of Availability of this Draft EIS to provide the public an opportunity to review and comment on the Draft EIS. All comments received during the 45-day public comment period, along with responses thereto, will be incorporated into the Final EIS. Responses to comments will be published as part of the Final EIS.

7.1.3.1 Notice of Availability

Notice of the availability of the Draft EIS, the opportunity to provide public comment, and a public meeting is provided in a number of ways:

- Notice of Availability published in the *Federal Register* on May 29, 2015
- Email sent to stakeholders, interested persons, and those who participated during scoping
- Updates to the project website included notice of the meeting date, time, and location as well as a Section 508 compliant version of the Draft EIS and all of its appendices along with all of the materials (fact sheets, exhibit boards) used at the public meeting
- Newspaper display ads announcing the public meeting in local and regional papers
- A press release sent to area news outlets

7.1.3.2 Public Meeting

A public open house is scheduled to solicit comments from the community about the findings presented in the Draft EIS. The open house will be held at the POTB, Officer's Mess Hall on June 17, 2015. This location is near the project area and is accessible to all persons. Comments received during the public meeting via written materials or presented to a court reporter will be entered into the public record.

7.1.3.3 Document Availability

An electronic version of the Draft EIS is available on the project website at http://southernfloweis.org. Hard copies of the Draft EIS are also available at the following locations during the public review period:

- FEMA Region X office, 130 - 228th Street SW, Bothell, Washington
- U.S. Army Corps of Engineers, 333 SW First Avenue, Portland, Oregon
- U.S. Fish and Wildlife Service, 911 NE 11th Avenue #1, Portland, Oregon

- Oregon Office of Emergency Management, 3225 State Street, Salem, Oregon
- Port of Tillamook Bay, 4000 Blimp Boulevard, Suite 100, Tillamook, Oregon
- Tillamook County, 201 Laurel Avenue, Tillamook, Oregon
- Tillamook Main Public Library, 1716 Third Street, Tillamook, Oregon

Compact disc (CD) copies of the document are available to anyone who requested a CD copy. Hard copies are also available for purchase at the expense of the requestor.

7.1.3.4 Comment Collection

Opportunities to participate in the review process include attendance at the public open house and review of the materials online or at several locations where hard copies have been made available. Comments can be made verbally at the open house where verbal testimony will be captured by a court reporter, or they can be submitted in a written format. Comments will be collected at the meeting and by mail, email, and fax. All comments received during the public comment period, along with responses thereto, will be incorporated into the Final EIS and published as part of the Final EIS.

FEMA is responsible for adopting the EIS as adequate in compliance with NEPA. FEMA will consider the EIS among other information when making the decision on whether the SFC project is in the best interest of the public. FEMA will complete a record of decision according to NEPA.

Each cooperating agency, including NOAA, USFWS, and USACE, will independently review and approve the Final EIS and issue its own decision document addressing the decision each agency needs to make with respect to the Proposed Action.

7.2 Agency Coordination

FEMA has developed this Draft EIS in coordination with federal, state, and local agencies, including NOAA's Restoration Center, USACE, USFWS, Oregon OEM, POTB, Tillamook County, OWEB, and the Tillamook Estuaries Partnership. For more detailed information, please see Section 1.3 (Lead and Contributing Agencies) and Section 9 (List of Preparers).

FEMA mailed invitation letters on May 9, 2014 to government agencies and tribes with a potential interest in the project. The letters provided information on scoping, how to provide comments, and details about the agency scoping meeting. FEMA held an agency scoping meeting on May 28, 2014 with 10 agencies and jurisdictions represented. The meeting was held in Portland, Oregon and was accessible via web link and telephone conference. All materials presented at the agency scoping meeting were posted on the project website for the entire scoping comment period so that any party who could not attend a meeting would have all of the materials available for review. Appendix B contains a copy of the scoping report, including comments received. The scoping report is also available on the project website at http://southernfloweis.org.

FEMA has coordinated with the cooperating agencies in preparation of this document by way of early coordination and pre-consultation through a series of site visits, meetings, and telephone conversations. As a result, guidance from direct coordination has been incorporated into the EIS. In addition, information from additional coordinating agencies has been incorporated where appropriate.

7.3 Government-to-Government Consultation

Federal government-to-government consultation with Native American tribes was conducted by FEMA for the EIS.

On February 4, 2014, FEMA initiated contact with the Confederated Tribes of the Grand Ronde Community of Oregon and the Confederated Tribes of Siletz Indians with a letter describing the Proposed Action. On June 2, 2014, FEMA submitted background information and the APE to the tribes. Appendix I contains tribal correspondence.

On August 5, 2014, FEMA met with the Grand Ronde to discuss the project and address specific tribal concerns and issues. On August 20, 2014, representatives from FEMA and Grand Ronde toured the study area.

Following the completion of the cultural resources survey report, copies were transmitted to both the Confederated Tribes of the Grande Ronde and the Confederated Tribes of Siletz Indians for their review and comment on March 11, 2015. The Grande Ronde provided feedback to the SHPO that an archaeological monitor should be present during work in some portions of the project area.

7.4 Consultation Pursuant to Section 106 of the NHPA

The National Historic Preservation Act is the primary federal legislation governing preservation of cultural and historical resources in the U.S. The NHPA established a national historic preservation program that encourages the identification and protection of cultural and historic resources. Section 106 of the NHPA is a provision that requires federal agencies to take into account the effects of their undertakings on historic properties, and they must afford the Advisory Council on Historic Preservation an opportunity to comment with regard to the undertaking. Section 106 is implemented by regulations found at 36 CFR Part 800 that guide the consultation process. FEMA has elected to integrate compliance with Section 106 of the NHPA through the NEPA process as allowed under 36 CFR Part 800.8(c).

On February 4, 2014, FEMA initiated formal Section 106 consultation with the Oregon SHPO with a letter describing the Proposed Action. On June 2, 2014, FEMA submitted background information and the proposed APE to the SHPO for concurrence. On June 24, 2014, SHPO concurred with the APE and approved a site investigation research design.

A cultural resources survey of the APE was conducted and concluded there are no historic or cultural resources eligible for listing in the National Register. On April 16, 2015, the SHPO concurred with the finding that the Proposed Action would have no effect on built environment historic properties. Consultation on potential effects on archaeological resources is ongoing.

Appendix I contains Section 106 correspondence. Section 4.8 provides further discussion on the historic and cultural resources in and near the project areas and on the effects findings.

7.5 Endangered Species Act Consultation

The Endangered Species Act provides for the conservation of federally endangered and threatened species and the ecosystems upon which they depend. Section 7 of the ESA requires federal agencies to aid in the conservation of listed species and ensure the activities of federal agencies do not jeopardize the continued existence of listed species or adversely modify designated critical habitat. The USFWS and NOAA Restoration Center are the lead agencies for compliance with ESA for this project; USFWS is leading the consultation on Marbled murrelets, and NOAA is leading the consultation on fisheries effects.

USFWS prepared a BA for Marbled murrelets. The USFWS is consulting with their regulatory branch about potential impacts on Marbled murrelets and Bald Eagle. That consultation is ongoing, and a biological opinion will be prepared before the Final EIS is completed that identifies conservation measures to be implemented to minimize potential impacts on murrelets and eagles. These measures are not expected to be very different from those described in Section 6.

In consultation with NMFS, NOAA Restoration Center has determined PROJECTS would apply to the Proposed Action as currently described (NMFS 2013). This consultation is also ongoing and the conclusions will be confirmed as the proposed project design plans are further refined. The applicable measures from PROJECTS are described in Section 6 and the proposed project would need to conform to the project design criteria included as Attachment B of Appendix G.

Section 4.6.3 provides further discussion on the existing conditions and potential effects on listed plant and animal species.

7.6 Environmental Justice – EO 12898

The 1994 Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires all federal agencies to identify and address disproportionately high and adverse human health or environmental effects of programs on minority and low-income populations.

Section 4.9.2 of this EIS provides further discussion on environmental justice issues. Section 4.9.2 evaluates potential effects on environmental justice communities and concludes that while there are minority and low-income populations near the project area, they would not be adversely or disproportionately affected by the alternatives.

7.7 Permits

The following permits would be required for construction and implementation of the Proposed Action.

Federal:

- USACE Individual Section 404 Permit for discharge of dredged or fill material into waters of the United States, including wetlands
- Incidental Take Permit associated with the Programmatic Biological Opinion issued by NMFS for effects to Oregon Coast coho salmon

- Incidental Take Permit issued by USFWS for effects to Marbled murrelet
- Bald Eagle Permit issued by USFWS for construction disturbance and permanent alteration of vegetation near an active nest

State:

- Oregon Department of State Lands Removal-Fill permit for placement of fill in and/or removal of fill material from wetlands and waters of the state. Because the waters of the proposed project area are designated as essential salmon habitat, any amount of fill or removal would require permit authorization.
- Section 401 Water Quality Certification to ensure activities will meet water quality standards, to be reviewed and approved by Oregon Department of Environmental Quality.
- Oregon Department of Land Conservation and Development Coastal Zone Management Act Consistency Certification.
- Traffic control permits from ODOT, if needed, to mitigate for construction truck traffic turning onto Highway 101.
- Oregon Department of Fish and Wildlife requirements for in-water work timing, fish passage, and fish and wildlife habitat mitigation for projects where loss of fish and/or wildlife habitat is expected. Project must demonstrate it meets these requirements through the Fill/Removal permit application and review process.

Tillamook County:

- Tillamook County Development Permit to ensure the project is consistent with the applicable local planning requirements. A development permit would also be required for construction within a mapped floodplain.
- City/County of Tillamook conditional use permits may be required for temporary staging areas or other construction-related activities. Proposed log stockpile on City property may require a conditional use permit.

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SECTION 9 List of Preparers

Federal Emergency Management Agency

Reviewers	Role in Preparation
Mark Eberlein, Regional Environmental Officer	Technical review and approval
Bill Kerschke	Technical review and approval; Project Manager
Barry Gall	Technical review and approval; biological resources, hydrology
Jessica Stewart	Technical review and approval; cultural resources

NOAA Restoration Center

Reviewers	Role in Preparation
Melanie Gange	Technical review and approval
Lauren Senkyr	Technical review and approval
Megan Hilgart	Technical review and approval

U.S. Fish and Wildlife Service

Reviewers	Role in Preparation
Amy Horstman	Technical review and approval

U.S. Army Corps of Engineers

Reviewers	Role in Preparation
Dominic Yballe	Technical review and approval

State and Local Agencies

Reviewers	Role in Preparation
Julie Slevin, OEM	Technical review and approval
Aaron Palter, POTB	Technical review and approval
Paul Levesque, Tillamook County	Technical review and approval
Rachel Hagerty, Tillamook County	Technical review and approval

CCPRS

Preparers	Experience and Expertise	Role in Preparation
Mark Anderson, PE	Senior Civil Engineer	Hydrology and Hydraulics
Andrew Clem	GIS Specialist	GIS Analyses and Graphics
Todd Cotton, PE	Soil/Geotechnical Engineer	Geotechnical
Steve Dent	Civil Engineer	Hazardous Materials
Moosub Eom, Ph.D., PE	Water Resources Engineer	Fluvial Geomorphology
Kristin Hull	Senior Planner	Public Involvement
Jennifer Jones	Senior Biologist	NEPA Documentation, Biological Resources, Geology/Soils/Seismic, Coastal Resources, Hazardous Materials, Cumulative Effects
Sydney Kase	GIS Specialist	GIS Analyses and Graphics
Claudia Lea	Senior Environmental Engineer	Water Resources
Jay Lorenz, PhD	Senior Biologist	Biological Resources
Steve Mader, PhD	Senior Wetland Specialist	Kick-off Meeting, Technical Review
Daniel Malmon	Senior Hydrologist	Sediment, Hydrology
Brenda Martin	Transportation Planner	Traffic, Public Involvement
Robin McClintock	Architectural Historian	Cultural Resources
Ryan Mitchell, PE	Senior Civil Engineer	Hydrology and Hydraulics
Darren Muldoon, AICP	Transportation Planner	Traffic Analysis
Peggy O'Neil	Biologist	Vegetation, Wetlands
Chris Park, AICP	Environmental Planner	Introduction, Purpose and Need, Alternatives, Visual Quality and Aesthetics, Environmental Justice, Public Health and Safety, Recreation, Noise
Gwen Pelletier	Senior Environmental Planner	Air Quality, Climate Change
Lori Price	Architectural Historian	Cultural Resources
Kate Stenberg, PhD	Senior Biologist, Senior Planner	Project Manager, NEPA documentation, Biological Resources; Technical Review
Casey Storey	Biologist	Fish and Wildlife, Threatened and Endangered Species
Gina Veronese	Environmental Planner	Regional Economics
Julie Wilt	Archaeologist	Cultural Resources

Appendices